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THE RADIOLOGICAL EXAMINATION

OF THE OESOPHAGUS.

By

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M.B., Ch.B., D.M.R. & E.(Camb.)

Being a Thesis submitted for the Degree of

Doctor of Medicine

of the

University of Edinburgh.

MARCH 1930

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INTRODUCTION.

Until the discovery of the X-Rays by Röntgen in the latter part of I895, the existing methods for the examination of the oesophagus were either the blind passage of sounds or bougies, or direct examination by means of the oesophagoscope.

The method of blind sounding at best gave very little information, and was moreover dangerous from the risks which it involved of perforation of a diseased oesophageal wall, or of the rupture of a large aneurysm.

Oesophagoscopy, on the other hand, amounts to an operation, and demands in addition to the skilled laryngologist and his assistants, the use of a theatre, so that it can hardly be regarded as an out-patient procedure. It is also an alarming and unpleasant experience for the patient.

When Röntgen announced his discovery, it was applied to medical diagnosis with remarkable rapidity in all large centres. The earliest diagnostic use of the radiation was confined to the examination of the/

the bones and joints, and a little later, the chest.

Some of the earliest workers turned their attention to the means of applying the new agent to the inspection of the hollow viscera. It was early realised that if this was to be done some contrast medium must be introduced into the lumen of the viscus, in order to differentiate its shadow from those of the surrounding tissues of similar density. Some of the earliest attempts to outline the oesophagus and stomach involved the swallowing by the patient of such objects as wire spirals - hardly a safe or pleasant proceeding.

The earliest record of an opaque meal - using a radio-opaque salt of a heavy metal - is by Strauss(1) who, in 1896, wrote as follows:-

> "It would of course be desirable in the "interest of patients if we could make use "of the radio-opaque properties of the metals "for diagnostic purposes, without subjecting "them to the discomforts associated with the "introduction of tubes. For this reason I "have carried out experiments in the follow-"ing manner. Taking the gelatine capsules "used for the administration of castor oil, "I have filled them with reduced iron oxide "and bismuth subnitrate. On screening, I "could make out only very indefinite shadows "of these objects. For the present I have "not continued these investigations, because "they appear to me to be of less practical "importance than the question of translucency "of pathological new formation to the Röntgen "rays."

David Walsh (2), in 1897, reported the faint outlining of the stomach and colon, with some coils of small/·

small intestine, in a patient who had taken fifteen grains of bismuth three times a day.

Cannon (3), in 1898, published in the American Journal of Physiology a paper on the movements of the stomach studied by the Röntgen rays. He also states that Dr. H.P. Bowditch in the autumn of 1896 suggested the use of the Röntgen rays as a means of watching the gastric motor activities under normal circumstances, and that his paper was the result of the work thus far completed. The animal used for the research was the cat, and the meal consisted of from fifteen to eighteen grammes of bread, mixed with milk, hot water, or gravy, and contained from one to five grammes of bismuth subnitrate. Then followed the first account of the movements of the stomach (of the cat) as observed on the fluorescent screen after the administration of an opaque meal.

The first reference to the use of an opaque meal for the examination of the oesophagus appears to be by Walsham (4), who, in 1903, discussed the X-Ray examination of the oesophagus with special reference to the detection of new growth. He states:-

> "It is a good plan when examining the chest
> "for a suspected oesophageal growth to give
> "the patient, before the screen examination,
> "two drachms of bismuth carbonate suspended
> "in a little milk or mucilage. This will
> "map out the oesophagus in a thin black shadow
> "to the seat of obstruction. Of course the
> "track of the oesophagus might be traced by
> "a metallic bougie, the former proceeding is
> "much less dangerous should the case turn
> "out to be one of aneurysm. Certainly it is
> "a much more pleasant procedure for the patient".

He/

He records two cases in which the oesophagus was mapped out by the bismuth method, and a diagnosis of carcinoma of the oesophagus made. This is precisely the method of radiological investigation of the oesophagus used at the present day.

The development of the opaque meal examination of the gastro-intestinal tract was not as rapid as it might have been, had it been realised sooner that large doses of insoluble pure salts of bismuth and barium are without any toxic action when ingested.

The first radiograph of a case of stricture of the oesophagus to appear in the Archives of the Röntgen Ray was by Thurstan Holland (5), and was published in 1904. It was taken after the patient had swallowed 2 ozs. of a strong barium mixture.

Radiological examination has rendered all blind methods entirely obsolete. It is not unpleasant and is devoid of risk to the patient. In many conditions, such as pharyngeal diverticulum, it gives as much information as the oesophagoscope, with far less trouble and discomfort to the patient. In other cases again it can give more information even than the direct examination - as in cases of compression of the oesophagus from extrinsic pressure. In these cases, the oesophagoscope can in most cases only show that the cause of the narrowing is outside the lumen of the gullet - the radiological examination will in most instances/

instances demonstrate the actual cause of the pressure.

It must be admitted that there are certain cases in which the radiological findings are either indefinite, or entirely negative, and in which oesophagoscopy is the only means of diagnosis. The chief examples of this class are simple tumours of the oesophagus, many of the cases of peptic ulcer, and transradiant foreign bodies.

Since the image on the fluorescent screen or on the film is simply a record of the various densities through which the X-Ray beam has passed on its way from the tube, it follows that pathological processes can only be demonstrated in so far as they cause changes in density and changes in contour of structures, the normal outline of which is known to the observer. Thus superifical ulceration of the mucosa, whether peptic, or due to such infections as tubercle or syphilis, will not give any direct evidence of its presence. Only if it gives rise to reflex spasm, or later to cicatricial stenosis with consequent narrowing of the oesophagus and obstruction, will it alter the X-Ray appearances. Even then, all that can be determined is that there is spasm, or a stricture. The precise nature of the causal pathological process can in most cases only be determined by direct examination, possibly including the removal of/

of tissue for histological examination.

In conclusion, it may be said that radiology is of almost equal importance to the direct examination, and ought in all cases, (except certain ones of foreign body with acute obstructive symptoms) to precede the latter. It is of great importance in excluding the possibility of aneurysm, which would contra-indicate oesophagoscopy, and will indicate the position and probable nature of any stenosis. In many cases the need for direct examination will be removed.

This thesis is an attempt to indicate both the possibilities and the limitations of the radiological method.

After a brief discussion of the anatomy and physiology of the oesophagus, and of the technique of its radiological examination, the various pathological conditions met with are treated in their appropriate sections. In these, the symptomatology has been fairly fully dealt with, since it is of the greatest importance that before making an examination, the radiologist should take the patient's history, in order that he may be prepared for the possible conditions with which he may be dealing, and may plan his procedure accordingly.

At the end of each section, prints from radiographs, illustrative of the condition, are given, with/

with a brief note of the clinical history, and the findings at the radiological examination.

I wish to thank Dr. Woodburn Morison for his kindness in allowing me to make use of the material used for the illustrations, all of which are from radiograms taken in the course of routine examinations made in his Department at the Royal Infirmary, Edinburgh.

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M.R.C.S.

ANATOMY AND PHYSIOLOGY OF THE OESOPHAGUS.

The oesophagus is a muscular tube extending from the termination of the pharynx, at the inferior border of the cricoid cartilage, opposite the sixth cervical vertebra, to the cardiac orifice of the stomach, at the level of the eleventh dorsal vertebra.

In the first part of its course, in the lower part of the neck and the superior part of the thorax, it lies slightly to the left of the median plane, projecting beyond the left border of the trachea to the extent of ¼ inch. At the level of the fourth dorsal vertebra it returns to the median plane, passing behind the arch of the aorta at this level. At the level of the seventh dorsal vertebra it again diverges to the left, crossing in front of the aorta, and at the eighth dorsal vertebra passes forward to reach the oesophageal opening of the diaphragm, which lies to the left of, and anterior to, the Aortic Opening, at the level of the tenth dorsal vertebra.

It is also curved in the antero-posterior direction, thus conforming to the curvature of the vertebral column, upon which in great part it lies.

The length of the oesophagus varies in different individuals from eight to fourteen inches.

When seen in frozen sections it usually appears as a flattened tube with a narrow, slit-like cavity, with/

with its walls in apposition; or as a rounded tube with a stellate lumen.

The oesophagus normally shows three definite constrictions, one at its beginning behind the cricoid cartilage, one at the point where it is crossed by the left bronchus, opposite the fifth dorsal vertebra, and a third at the diaphragmatic opening. In addition, radiological examination always shows a diffuse flattening of the lumen where the gullet passes behind the aortic arch, at the level of the fourth thoracic vertebra,and is pressed upon by it. At all these points the flattening is from before backwards.

In the cervical portion the anterior and posterior walls lie in apposition in the resting condition. It is said that in the thoracic part the lumen may be held open by negative intra-thoracic pressure, but screen examination of the barium filled oesophagus suggests that this is unusual, the walls being here also in apposition, until they are separated by the descending bolus.

Sphincters:

The upper orifice of the oesophagus is formed by the lower fibres of the inferior constrictor, and thus belongs rather to the pharynx than to the oesophagus. The anterior lip of the orifice, which is thin, is attached by a tendinous slip to the median groove/

groove on the cricoid cartilage. The posterior lip is formed by a thick band of striated muscular fibres derived from the crico-pharyngeal portion of the inferior constrictor.

When these fibres contract, they close the upper end of the oesophagus by drawing the posterior lip forwards against the cricoid. Though anatomically part of the pharynx, this crico-pharyngeal sphincter is functionally that of the upper end of the oesophagus.

Anatomically, it is not possible to distinguish a cardiac sphincter, but about an inch above the lower end of the gullet there is a specialised portion of the circular muscular fibres about one inch in length, which as was pointed out by Keith, is functionally the sphincter of the cardiac orifice, and is known as the cardiac sphincter.

Normally, both these sphincters are in a state of tone, except during the act of deglutition.

Relations of the Oesophagus:

In the neck, the trachea lies anteriorly, the oesophagus being loosely connected to its membranous posterior wall by areolar tissue. The recurrent laryngeal nerves lie in the grooves at each side between the trachea and oesophagus. Posteriorly, it is separated from the vertebrae and longus colli muscles/

muscles by the prevertebral layer of the cervical fascia. On each side is the carotid sheath, the corresponding lobe of the thyroid gland and the inferior thyroid artery.

In the thorax, the oesophagus passes successively through the superior and posterior mediastina. In the former it is closely applied to the vertebral column, but in the latter, it lies further forward and comes into contact with the posterior surface of the pericardium. The trachea lies in front of it until its bifurcation at the level of the fifth dorsal vertebra, the left bronchus crossing and indenting it immediately below. It is below this level that the oesophagus is in contact with the pericardium. In the upper part of the thorax it lies upon the longus colli muscles and the vertebral column. Below the bifurcation of the trachea it is separated from the spine by the vena azygos, the thoracic duct, the upper five aortic intercostal arteries on the right side, and in its lower part by the aorta.

The diaphragmatic portion, about half an inch in length, is that portion of the gullet which lies within the oesophageal opening of the diaphragm. The direction of this orifice is very oblique, passing forwards and to the left, and but little downwards

The/

The epicardial portion is the very short part, again some half an inch in length, which lies below the diaphragm.

Relation of the Aorta to the Oesophagus:

The arch of the aorta, in passing back to reach the vertebral column, crosses the gullet to reach its left side. Thus the descending aorta lies to its left. Further down the aorta comes to lie on the anterior surface of the spine, and the oesophagus passes forwards to lie in front of it. As the diaphragm is approached, the aorta comes to lie somewhat to the right of, as well as behind, the oesophagus.

Structure of the Oesophagus:

The wall is composed of three coats:

(1) Tunica Muscularis.

(2) Tunica Submucosa.

(3) Tunica Mucosa.

It is in addition surrounded by an outer covering of areolar tissue, the Tunica Adventitia, by which it is loosely connected to the various adjacent structures throughout its course. This loose covering allows of changes in position and of size on deglutition.

The Tunica Muscularis consists of two layers, an outer of longitudinal, and an inner of circular fibres. The Longitudinal layer is well developed, its fibres forming, along the greater part of the length/

length of the tube, an even covering outside the circular layer, and becoming continuous below with the longitudinal fibres of the gastric wall. Above, near the superior end of the oesophagus, the longitudinal fibres, separating at the back, pass round towards the anterior aspect, forming two longitudinal bands which run up on the anterior aspect of the gullet to become attached by a tendinous band to the superior part of the posterior surface of the cricoid cartilage.

The circular fibres do not form so well developed a layer as the longitudinal. Below, they are continuous with both the circular and the oblique fibres of the stomach. Above, they pass into the lower fibres of the inferior constricter of the pharynx. At the upper end, the muscle fibres are entirely of the striated variety. Soon unstriped fibres appear, increasing in numbers with descent, until in the lower half of two thirds, only unstriped fibres are present.

The Tunica Submucosa, composed of areolar tissue, is of considerable thickness in order to confer the quality of distensibility upon the tube. It connects the mucosa loosely to the muscular coat. The submucosa contains numerous racemose glands which open into the lumen of the oesophagus.

The Tunica Mucosa, of a firm and resistant texture/

texture, is covered with a thick stratified squamous epithelium, on the surface of which are found the openings of numerous glands. This coat is inelastic and is but loosely connected to the muscular coat by the submucosa. It is consequently thrown into deep longitudinal folds.

The arrangement of the longitudinal muscle fibres at the upper end of the oesophagus requires special consideration, in view of the importance of this region in connection with pharyngeal diverticulum.

The anatomy of this region has been very fully described by Birmingham, from whose paper on the subject the following notes and diagrams are abstracted. (A Study of the Arrangement of the Muscular Fibres at the Upper End of the Oesophagus." Prof. A. Birmingham. Jour. Anat. & Physiol. Vol. XXXIII. P.10.)

The longitudinal fibres of the oesophagus arise by a stout tendon - quarter of an inch in width above, wider below - from the upper end of the vertical ridge on the back of the cricoid. This tendon, somewhat below the middle of the cricoid, gives rise to two stout muscular bands, which lie close together on the front of the tube at their origin, but diverge immediately below this, passing round on the lateral aspect, and gradually spreading out in a dorsal direction, until finally, at a point about one and a half inches below the cricoid, the fibres of the opposite/

opposite sides meet behind, and form, from this point downwards, all round the tube, a continuous layer of longitudinal fibres. Thus, posteriorly, a V-shaped interval is left between the diverging lateral bands. This interval measures nearly one and a quarter inches from above downwards. The interval is filled in by the circular fibres of the oesophagus, covered over in its lower and greater part by thin and scattered longitudinal fibres derived from the outer layer, and above for nearly half an inch by the lowest fibres of the inferior constrictor, which pass down for a short distance over the upper part of the oesophagus, overlapping and blending with its highest circular fibres.

The circular fibres of the oesophagus end as follows:- Posteriorly by becoming continuous with the corresponding fibres of the oesophageal fibres of the inferior constrictor; on the lateral aspect, the highest fibres form a small bundle, which is united on each side to the margin of the common tendon of the longitudinal fibres, and thus to the cricoid; whilst anteriorly, they grow gradually thinner, and finally cease a little below the level of the junction of the longitudinal bands with their common tendon.

The V-shaped interval between the two diverging masses of longitudinal fibres referred to above has been/

been called the "triangle of Laimer". This has been erroneously stated by various writers to be the site of origin of pharyngeal diverticulum.

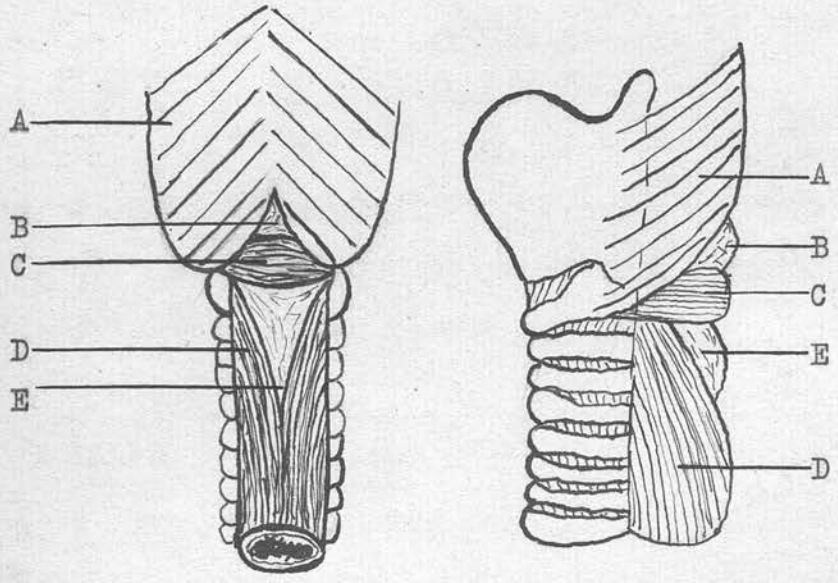
These lower fibres of the inferior constrictor muscle, shown at (C) in the diagram on P. ~, constitute the crico-pharyngeus muscle, which has been shown by Keith and others to be a true sphincter of the upper orifice of the oesophagus. It is this muscle which is normally in a state of tonic contraction, and which is found to be in a state of spasm in patients who have a pharyngeal diverticulum. It therefore follows that the pouch in this condition must arise from the posterior wall immediately above this muscle, and below the more obliquely placed and decussating fibres of the upper parts of the inferior constrictor. Further, in this position there are no circular fibres on the interior of the pharyngeal wall, and on the posterior and external aspect a minute triangular space is to be found when the fascia and connective tissue in this region have been removed.

Abel states, from the examination of several specimens, that the muscle fibres which form the superior boundary of the orifice of a pharyngeal diverticulum are the decussating fibres of the inferior constrictor exclusive of the crico-pharyngeus, whilst the fibres which lie below the orifice are the horizontally/

horizontally placed, non-decussating fibres of the crico-pharyngeus.

There is thus a small triangular area on the posterior pharyngeal wall, bounded below by the crico-pharyngeus muscle and above and laterally by the decussating fibres of the inferior constrictor, which, lacking the strengthening element of the longitudinal fibres of the oesophagus, which have diverged from each other just below this level, constitutes a point of weakness of the wall, and is the site of origin of the pharyngeal diverticulum.

Diagrams of the Arrangement of the Muscular Fibres at the Pharyngo-Oesophageal Junction.



Dorsal Aspect

Lateral Aspect.

A B C Lower portion of inferior constrictor muscle.

A Obliquely placed decussating fibres.

C Horizontal fibres forming crico-pharyngeus muscle, or superior sphincter of the oesophagus

B Triangular space between these, which is the site of origin of pharyngeal diverticulum.

D Longitudinal fibres of the oesophagus.

E Triangular space erroneously considered by some to be the site of pharyngeal diverticulum.

Innervation of the Oesophagus:

The oesophagus receives its nerve supply from two main sources:-

(1) Parasympathetic, through the vagi and the recurrent laryngeal nerves.

(2) Sympathetic, from the cervical and thoracic portions of the sympathetic chain.

(1) The Parasympathetic Supply: In the neck, the gullet is supplied by the recurrent laryngeal branch of the vagus. Both nerves supply numerous branches to the oesophagus.

In the thorax, the middle of the oesophagus receives numerous branches from the pulmonary plexus of each side. After forming the pulmonary plexi, the two vagi converge towards the oesophagus, to break up upon its surface and form the peri-oesophageal plexus. From the lower extremity of this, the two nerves again emerge, to leave the thorax through the oesophageal orifice of the diaphragm, the right posterior; and the left anterior to the oesophagus.

(2) The Sympathetic Supply: In the neck, branches are received from:-

(a) The superior cervical ganglion, and through this from the first to the fourth cervical nerves.

(b) The inferior cervical ganglion, formed by rami communicantes from the seventh and eighth cervical nerves.

The recurrent laryngeal nerve is joined by a branch from this ganglion.

The superior cervical ganglion sends branches to the glossopharyngeal, vagus and hypoglossal nerves.

In/

In the abdomen, the gullet receives several fine filaments from the coeliac plexus on each side.

The branches of the sympathetic and parasympathetic systems, on reaching the oesophagus, break up to form terminal plexi, in which groups of ganglion cells are embedded. These cells, together with their connecting fibres, form the intrinsic plexus of Auerbach, which lies between the longitudinal and circular layers of the muscle fibres.

That this local nervous system is capable of regulating the movements of the musculature independently of the control of the extrinsic nerves (as is also the case elsewhere throughout the alimentary tract) is proved by the experimental observation that rythmic movements persist in isolated sections of oesophagus removed from recently killed animals.

Auerbach's plexus is not found in the upper few centimetres of the gullet, where the muscle is of the striated variety. The gradual replacement of these fibres by unstriated ones as the oesophagus is descended is accompanied by a progressive increase in the number of ganglion cells.

It has been shown experimentally that section of the vagi, without stimulation, is followed by dilatation of the oesophagus, without relaxation of the cardiac sphincter. Stimulation of the peripheral ends of the divided vagi causes contraction throughout the oesophagus,/

oesophagus, but dilatation of the cardiac sphincter, as takes place in normal deglutition.

The Act of Deglutition.

The process of swallowing differs somewhat in its mechanism, according to the nature of the matter swallowed, i.e., whether it is a liquid, or a semi-solid or solid.

When a liquid is swallowed, it is propelled backwards past the fauces by an active voluntary contraction of the muscles of the floor of the mouth and of the upper part of the pharynx. The naso-pharynx and oropharynx are shut off by an upward and backward movement of the tongue, and by contraction of the muscles of the soft palate. Respiration is inhibited and the larynx is drawn upwards and forwards so as to prevent the passage of the food into the trachea. The stimulus occasioned by the contact of the liquid with the posterior pharyngeal wall then initiates a reflex which causes an inhibition of the upper and lower oesophageal sphincters. The further passage of the liquid down the oesophagus is mainly due to the effect of gravity, and is extremely rapid.

When a solid or semi-solid is swallowed, its contact with the posterior pharyngeal wall again reflexly inhibits the upper oesophageal sphincter. The force of the pharyngeal contraction then hurls the bolus through this relaxed sphincter into the upper/

upper end of the oesophagus. The further passage of the bolus is the result of a peristaltic contraction of the oesophageal walls, and is relatively slow, as compared with the almost instantaneous passage of liquids. The upper sphincter contracts as soon as the bolus has passed it, so preventing its regurgitation from the pressure set up by peristalsis. The descending wave of contraction is normally preceded by a wave of relaxation. This ensures that the cardiac sphincter is relaxed when the bolus reaches it, and allows the food to be propelled through it into the stomach by the following peristaltic wave, without resistance. Rhythmic regurgitation of the stomach contents into the lower end of the gullet occurs, followed by contractions of the latter which drive them back again. As soon, however, as the stomach contents become acid, with the progress of digestion, this process ceases, and the sphincter remains closed. This phenomenon was described by Cannon ("Mechanical Forces of Digestion", 1911.) as the "acid control of the cardia".

Deglutition is essentially a reflex act, and once food has entered the oropharynx it is beyond voluntary control. There is a centre for the reflex, situated in the floor of the fourth ventricle, above the respiratory centre. The afferent path of the reflex arc is formed by the second and third branches of/

of the trigeminus, and the sensory fibres of the vagus.

The passage of the contraction wave along the oesophagus is dependant upon the intracentral connections. The integrity of the muscle is not essential; ligature or even complete division of the tube does not arrest the wave.

The sympathetic is the constrictor, and the vagus the dilator of the oesophageal sphincters. Reciprocal innervation of the sphincters is present, relaxation taking place when the rest of the muscular wall contracts.

It has been shown that when the diaphragm descends in inspiration, the oesophagus is compressed between the crura; thus regurgitation of stomach contents as a result of the increased intra-abdominal pressure is prevented, whatever the state of tonicity of the cardiac sphincter may be at the moment, The aorta passes behind the diaphragm, while the opening of the vena cava is situated in the central tendon. This arrangement ensures that these structures are not compressed during the descent of the diaphragm.

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TECHNIQUE OF THE RADIOLOGICAL EXAMINATION OF THE OESOPHAGUS.

Since the oesophagus is a soft tissue tube deeply embedded amid tissues of very similar density, the use of a contrast medium is essential for its visualisation.

In the early days of radiology it was the custom to use for this purpose gelatine capsules some 2 cm. in length, by 1 cm. in diameter, filled with a bismuth or barium salt.

This procedure is to be condemned, as many normal people have the very greatest difficulty in swallowing even small pills. This functional peculiarity renders an examination made by means of these capsules open to grave fallacy, for they may be held up by a purely functional spasm at any part of the gullet, though most often at its junction with the pharynx, although in the same individual articles of ordinary food of equal size give rise to no difficulty at all.

The most satisfactory contrast medium is a simple mixture of chemically pure Barium Sulphate and water. The correct consistency of this mixture is such that a teaspoon will remain upright when thrust vertically in the paste in the bowl.

The most important part of the examination is that made with the fluorescent screen. Photographs are/

are also taken.

Position of the Patient:

If the patient be examined in the anterior position, the shadow of the barium filled oesophagus is superimposed upon the very dense shadows of the vertebral column and aorta. It is therefore poorly defined, as a result of the lack of contrast.

If the patient be turned about his vertical axis through some 30°-40° either to the right or to the left, a position is reached in which the beam of X-Radiation from the tube is able to pass between the vertebral column behind and the aortic arch and pericardium in front, and to project upon the screen a clear image of the superior and posterior mediastinal spaces, in which lie the oesophagus and the trachea. The most generally useful of these positions is that known as the Right Anterior Oblique. This position is illustrated in the diagram, Plate 2. In this position, the patient is placed in the screening stand with his right breast in contact with the back of the screen, and his left scapula towards the tube.

With the patient in this position, the lefter-most portion of the screen shows a foreshortened image of the right lung. To the (observer's) right of this is the vertical shadow of the spine. Between this and the cardio-vascular shadow still further/

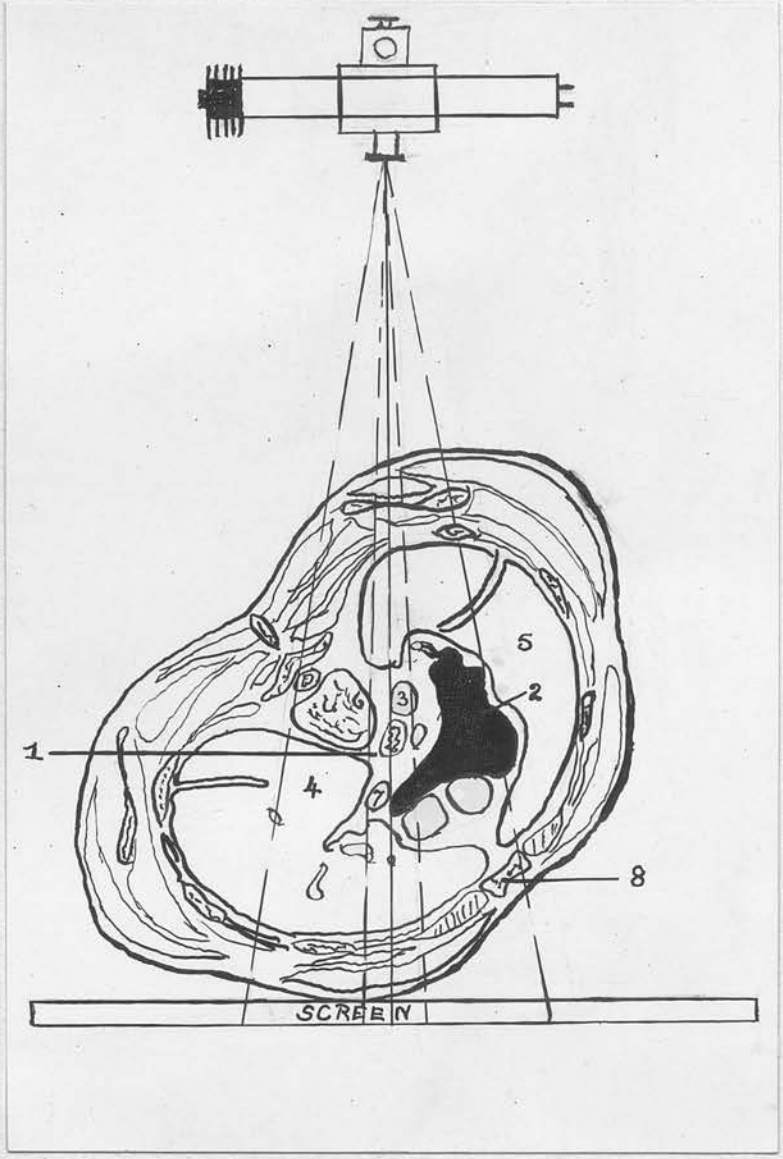

Plate (2).

Diagram to illustrate the relative positions of the patient, the fluorescent screen and the X-Ray tube in the right anterior oblique position. It shows how the shadow of the barium filled oesophagus is projected clear of the shadows of the spine and of the heart and aorta. The level of the cross section of the trunk is that of the 3rd. costal cartilage.

I. Oesophagus. 2. Heart. 3. Descending Aorta.

4. Right Lung. 5. Left Lung. 6. Vertebral Body.

7. Ascending Aorta. 8. Body of Sternum.

further to the right, is a vertical, parallel sided, brightly lighted strip corresponding to the posterior mediastinal space. It is in this space that the shadow of the barium filled oesophagus is clearly visualised.

The patient is placed in the screening stand and is first made to face the observer, any abnormality in the cardio-vascular shadow, or in the lung fields being noted. He is then turned into the right anterior oblique position, the optimum angle being found by trial. In the absence of any dilatation of the aorta, the ascending and descending portions are superimposed, so as to produce a parallel sided shadow continuous below with that of the heart. The transverse portion of the arch, however, makes the upper extremity of this shadow slightly bulbous, the oesophagus being visibly indented by it.

The posterior mediastinal space is next examined for the presence in it of any foreign shadow. Oesophageal carcinomata of appreciable size usually show an abnormal shadow in this space before any barium has been given.

The patient, having been told not to move from this position, is now given a spoonful of the barium paste, but is instructed to hold it in his mouth until told to swallow. When the observer is ready, the patient is told to swallow and the passage of the barium/

barium is followed by means of the screen.

A fluid barium mixture passes down to the cardia almost instantaneously, and is therefore practically useless for the examination of the oesophagus, as there is no time for observation.

The thick barium paste already described must be used. When a mouthful of this is swallowed it is projected suddenly into the upper end of the oesophagus by the muscles concerned in the first part of the act of deglutition. Thereafter, its passage is comparatively slow, the time taken by the bolus in reaching the cardia being from ten to fifty seconds. The time required is largely dependent on the thickness and viscosity of the barium mixture which is being used.

There is normally a slight delay at the level of the cricoid cartilage and again where the oesophagus is indented by the aortic arch.

As the bolus slowly descends, it may be seen to open up the lumen of the oesophagus in front of it, the walls falling together again once it has passed. There is generally a distinct delay at the cardia, after which the barium passes through the cardiac orifice in a thin, uniform stream.

The epicardial portion of the oesophagus is best studied at the same time as the fundus of the stomach, which should be examined as well as the oesophagus in every instance, for carcinoma of the cardiac portion of/

of the stomach frequently gives rise to dysphagia as a prominent symptom.

In order to outline the cardia, the patient is given from 10 to 20 ozs. of the thin barium suspension which is ordinarily used for the routine examination of the stomach, and is placed in the supine position on the couch. This should be slightly raised at the foot, so as to direct the barium towards the fundus. In this way, with the screen resting on the upper abdomen, the whole fundus of the stomach may be outlined. If the patient is now made to swallow some more of the thick paste, while still lying supine, the lower end of the oesophagus, including the epicardia, can be demonstrated as a shadow continuous below with that of the fundus. This procedure, known as "Retrograde Radiography" is also used in order to fill the lower end of the oesophagus below a partial stricture, so as to determine the level of its lower extremity.

There are certain cases of early stricture, most often seen in the post-cricoid region, and in which there is probably a considerable spasmodic element, which offer so little resistance to the passage of the smooth barium paste that it may give little or no indication of the presence of a lesion. In doubtful cases, it is advantageous to mix with the barium paste a considerable proportion of dry bread crumbs. This/

This stiffens the mixture, and renders it more liable to be arrested by a partial stricture, and in addition, being more irritating than the bland barium paste, it is more likely to irritate the lesion and so to evoke any latent tendency to spasm which there may be. When any abnormal appearance is seen on the screen, films should be exposed in the right anterior oblique position, the exposure being made as short as possible in order to minimise blurring of the outlines of the shadow from respiratory and cardiac movements.

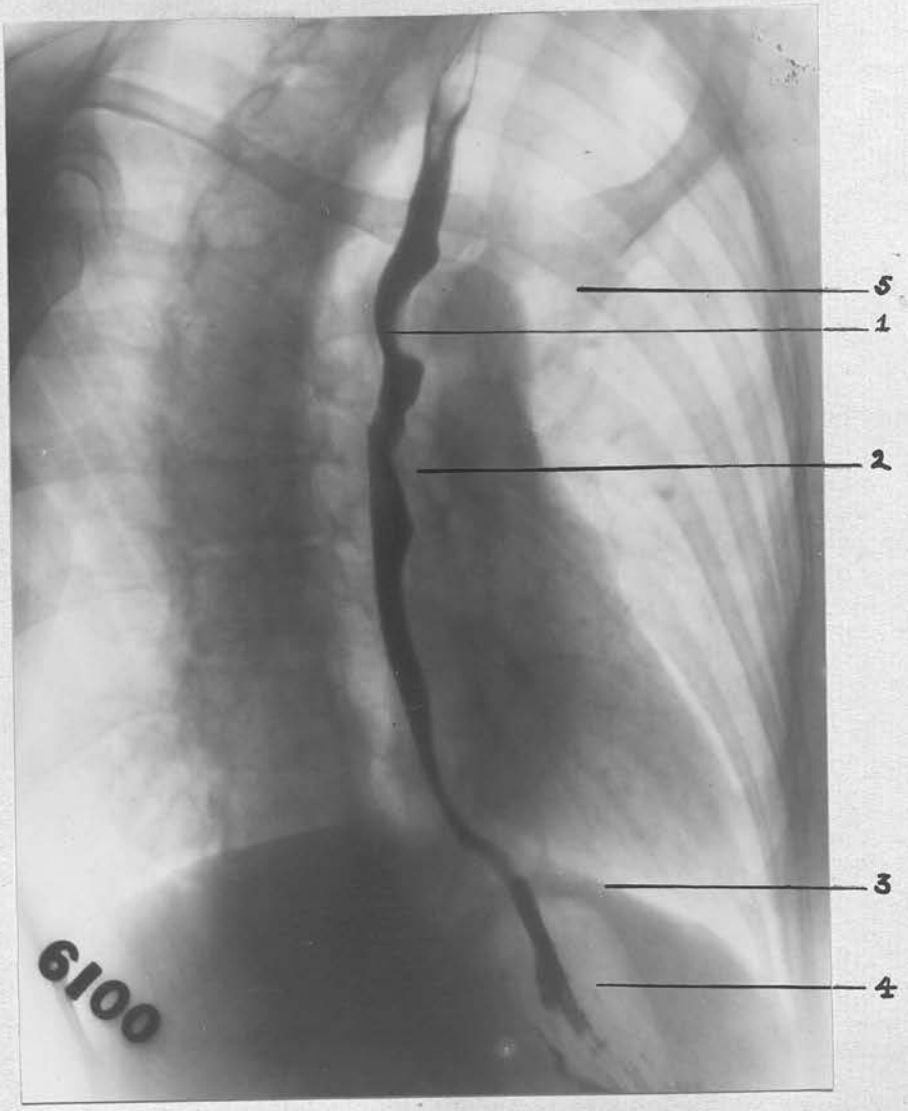

Plate (3).

The Normal Barium-Filled Oesophagus.

The patient is in the Right Anterior Oblique position. The various normal constrictions are well seen.

(I). Constriction at level of Aortic Arch.

(2). Bifurcation of Trachea, showing constriction at that level.

(3). Left Diaphragm.

(4). Gas Bubble in Fundus of Stomach. The barium is seen passing down towards the lesser curvature.

(5). Manubrium Sterni.

CONGENITAL MALFORMATIONS.

The chief congenital anomalies met with in the oesophagus are:-

(1) Communications with the trachea or main bronchi.

(2) Atresia.

(3) A combination of these two conditions.

(4) Stenosis.

(5) Compression due to abnormal course of the subclavian artery.

(6) Shortness of the oesophagus, the whole or a part of the stomach lying in the thoracic cavity, in the posterior mediastinum.

Conditions 1, 2, 3 and 4 are readily diagnosed radiologically, if the child can be made to swallow barium. They are not usually compatible with life for more than a few hours or days, however.

The commonest of these anomalies is atresia, which may be total, or there may be only a partial obliteration of the lumen.

Congenital stenosis is rare. It usually conforms to the normal narrowings.

An abnormal course of the subclavian artery has been known to cause compression of the oesophagus, usually however, without symptoms.

Congenital short oesophagus is discussed at the end of the section dealing with para-oesophageal hernia.

CICATRICIAL STRICTURE.

The formation of scar tissue giving rise to stenosis most often follows the swallowing of caustic fluids, especially "lye" (caustic soda solution) and ammonia, frequently in unsuccessful suicidal attempts. Cicatrisation may also follow injury to the oesophagealwall by impacted foreign bodies, such as dental plates.

The scarring due to corrosive fluids is most frequently encountered in the middle third of the gullet and often involves a considerable length of the tube. Dense scar tissue is formed, which, encircling the gullet gradually contracts and produces a stricture. The narrowing is usually sudden. Below this abrupt constriction is a long, funnel-like narrowing, which characteristically is smooth in its outlines. The degree of obstruction is often extreme. The scarring may develop rapidly, within a matter of two or three months of the injury, or it may develop slowly, causing gradually increasing dysphagia during several years.

The stricture may be single or multiple, the single variety being in the majority.

There is usually an appreciable degree of dilatation of the oesophagus above the stricture, but this is never so marked as in cardiospasm.

Cicatricial stenosis may also follow infectious processes.

In rare cases it may be due to syphilis.

It/

It may also follow the healing of a peptic ulcer.

Symptoms:

The outstanding symptom is dysphagia, which increases as the stricture tightens. The obstruction increases gradually, until the stenosis and the congestion and oedema of the mucosa above may entirely prevent the passage of food, which is then regurgitated. If the stricture is high up, this occurs immediately; a longer time will elapse if it is low down. Since the obstruction may be partly dependent on congestion of the mucosa and upon spasm, as well as upon true stenosis, the degree of dysphagia may vary from day to day, the patient having his good and his bad days.

The typical radiological finding is a sudden narrowing of the lumen, with a long funnel-like constricted portion extending downwards from it and gradually decreasing in diameter. It is usually smooth-walled, in contrast to the gross irregularity of the walls of a malignant stricture.

The differential diagnosis from the last mentioned condition is given by the history, the age of the patient and by the smooth outlines of the barium shadow, and the absence of any tumour shadow in the posterior mediastinum. The degree of dilatation above the stricture is not of much value as a differential/

differential point, though it is usually greater in the case of the cicatricial lesion, for the duration of the disease is likely to be longer, thus allowing more time for dilatation to develop.

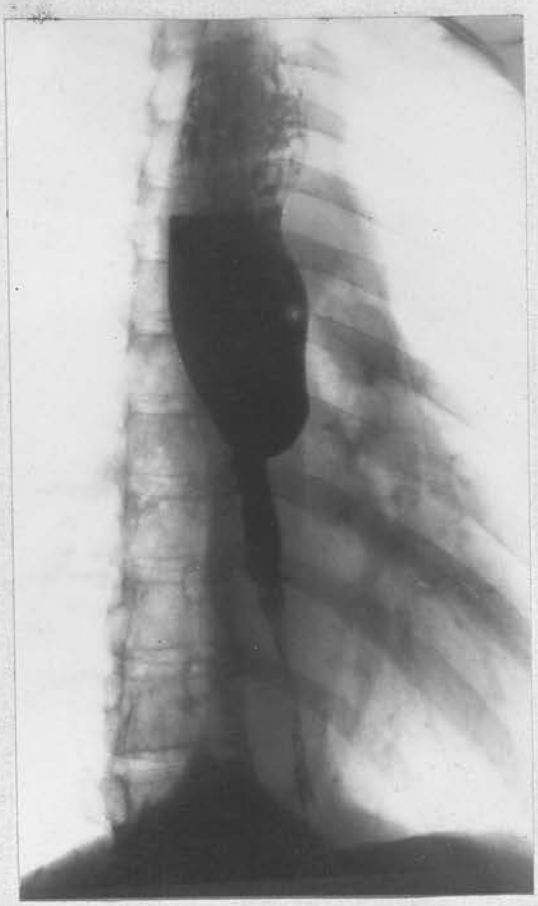

Plate (4).

Female. Age 38.

Cicatricial Stricture.

History: Three years before the date of examination, the patient swallowed strong ammonia solution. Since then, there has been increasing dysphagia.

Report of X-Ray Examination: There is a very definite stricture beginning at the level of the 7th. dorsal vertebra. The stricture is of considerable length, and is smooth walled. From the upper border of the stricture the barium trickled onwards in a thin stream into the stomach. There is marked dilatation of the oesophagus above the stricture.

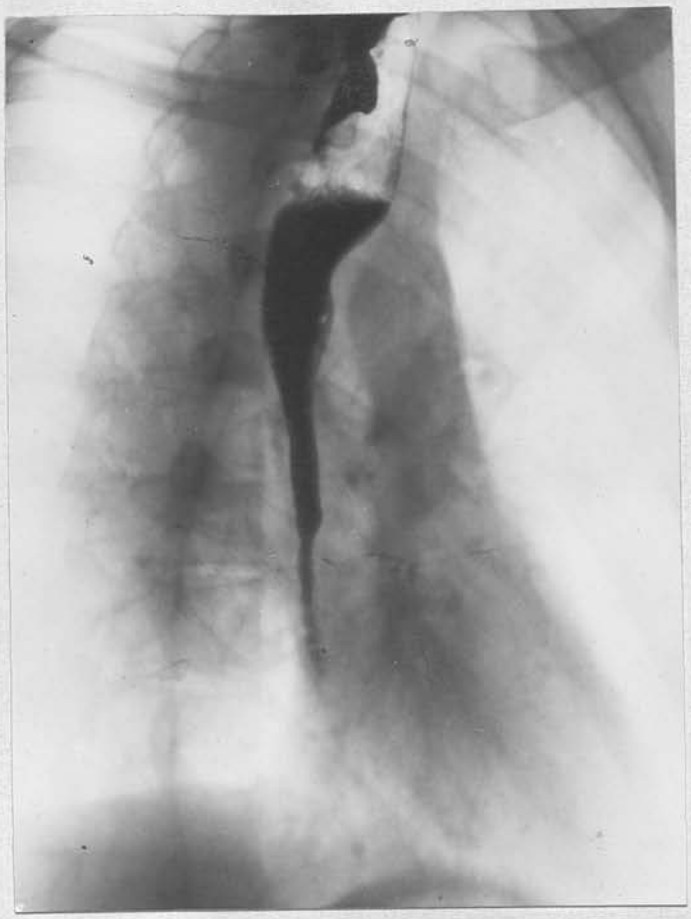

Plate (5).

Male. Age 31.

Cicatricial Stricture.

Complaint: Difficulty in swallowing solid food since childhood, when he swallowed a solution of Caustic Soda.

X-Ray Report: The thick barium paste was held up by a definite stricture in the mid portion of the oesophagus. The stricture is long and funnel-shaped, and presents the typical smooth outlines of a cicatricial stricture, in contra-distinction to the irregularity of malignancy. There is slight dilatation of the oesophagus above the stricture.

Plate (6).

Female. Age 45.

Cicatricial Stricture.

History: Ten weeks before the examination, the patient swallowed ammonia. She has since had recurring attacks of difficulty in swallowing solid food.

Radiological Examination: There is a stricture 4 inches above the diaphragm. It is smooth walled, and there is considerable dilatation of the oesophagus above. The barium was regurgitated immediately after the radiograph had been taken.

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SYPHILIS.

Syphilis of the oesophagus is a rare condition.

It may occur as a superficial lesion in the form of plaques, but more frequently it takes the form of a submucous gumma. This, when it breaks down, forms an ulcer with clear-cut, "punched-out" margins, which is thus quite unlike that of carcinoma. Stricture may result, in which case the radiological appearances do not differ essentially from those of other strictures of non-malignant origin.

An example of a cicatricial stricture due to syphilis is shown in Plate 7.

Plate (7).

Mrs. E.T. Age 46.

Syphilitic Stricture.

History: Her doctor reports:"she has suffered periodically from what looks like spasm of her oeso -phagus. Lately this has been worse, and she has on two occasions been completely blocked, so that she was unable to swallow even a mouthful of water".

X-Ray Examination with barium showed a stricture at the level of the cricoid. There was some dilata -tion of the hypopharynx above. The stricture is perfectly smooth walled and regular, the barium leaving in a thin stream from its lowest point.

The/

The appearances are those of a non-malignant stricture.

Endoscopic Examination: (Dr.J.S.Fraser.)

" The tube passed easily till it came to the post cricoid region: here there was a transverse narrowing with no appearance of ulceration or tumour. Jackson's rigid bougies passed through the stricture quite easily, up to and including the largest size.

Wassermann Reaction - Strongly positive.

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TUBERCLE.

Tubercle is most often seen in the middle third of the oesophagus.

The infection may reach the oesophagus in the following ways:-

(1) By direct extension from tubercular ulceration of the pharynx.

(2) From swallowed sputum.

(3) Extension from infected and caseating tracheal glands.

(4) A blood borne infection.

(5) By lymphatic spread from neighbouring organs.

An ulcer of varying extent forms and involves a varying amount of the circumference of the lumen. Considerable local thickening occurs, giving rise to rigidity and spasm. In rare instances a cicatricial stenosis may follow healing.

There are no special radiological appearances, but any narrowing or irregularity of the lumen which there may be will be shown on examination with barium.

PEPTIC ULCER.

Simple peptic ulcer of the oesophagus is a very rare condition.

The etiology is obscure, but it is most often seen in patients who are suffering from chronic vomiting, and there is usually associated gastric ulceration. The term peptic ulcer implies a localised destruction of the mucous membrane of the oesophagus from the digestive action of regurgitated acid gastric juice.

The ulcer occurs in the lowest part of the oesophagus, between the cardia and a point a little above the hiatus of the diaphragm.

It may be found at any age, but it is most common soon after thirty.

The lesion may be so shallow as to scarcely deserve the term ulcer, or it may be deep.

The exciting cause is regurgitation of acid gastric juice, and ulceration is most likely to occur if there is also pyloric stenosis. Local insufficiency of the blood supply, and faulty innervation are said to be predisposing factors.

The ulcers, which may be multiple, may heal spontaneously, and may then cause scarring with subsequent stenosis. On the other hand, they may erode blood vessels, or perforate into the pleura or abdominal cavity.

Symptoms:/

Symptoms:

These are pain, dysphagia, regurgitation of food and bleeding.

The pain, which may be very severe, is felt on swallowing, especially when the food is passing over the ulcer. It may also arise spontaneously, probably as a result of spasm.

It is most frequently epigastric in situation, less frequently in the region of the sternum or in the back, at the level of the diaphragm. The difficulty in swallowing, which is probably due to spasm, tends to grow progressively worse. This spasm is also the cause of the regurgitation.

Radiological Examination:

In very rare instances, if a deep ulcer is present, it may produce a visible filling defect or niche, like that of a gastric ulcer, when barium is swallowed. It must be emphasised that this is a very rare event. More often all that is found is a spastic contraction at the lower end of the gullet, with more or less obstruction. The spasm may relax entirely, or change its level slightly, while the screen examination is in progress.

If cicatricial stenosis has followed the healing of an ulcer, this will be demonstrated by the examination.

These remarks are illustrated by the case of H.H. (Plate 8) which is given on the next page.

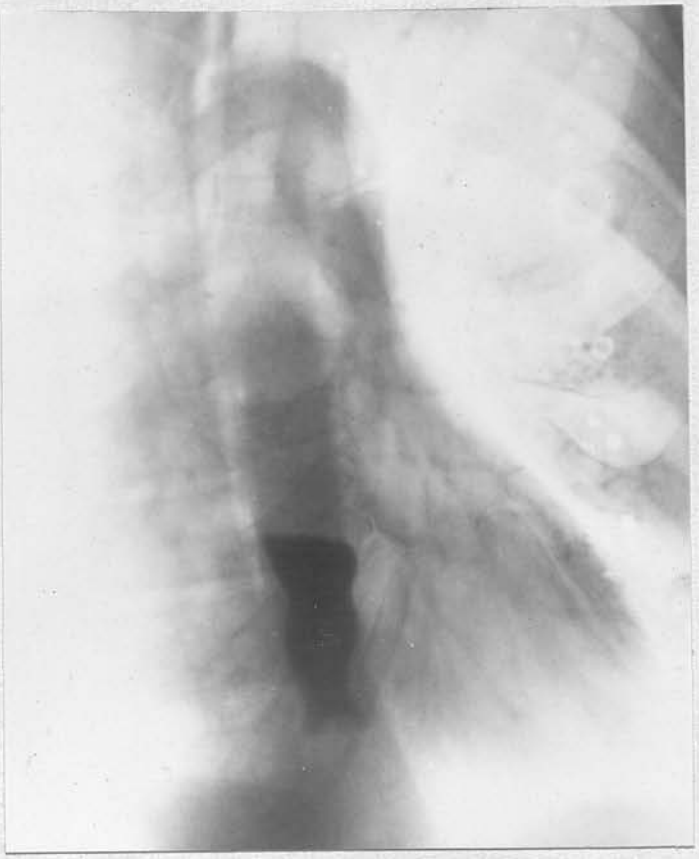

Plate (8).

H.H. Male. Age 57.

Spasm due to Peptic Ulcer.

Complaint: Dysphagia, and pain behind lower end of sternum on deglutition.

X-Ray Examination: There was a condition of intermittent spasm just above the cardia, but varying slightly in level from time to time. Obstruction was marked except when the spasm relaxed, and There was very definite peristalsis. This is best seen in the plate on the next page.

The condition was found to be a peptic ulcer of the oesophagus, just above the cardia.

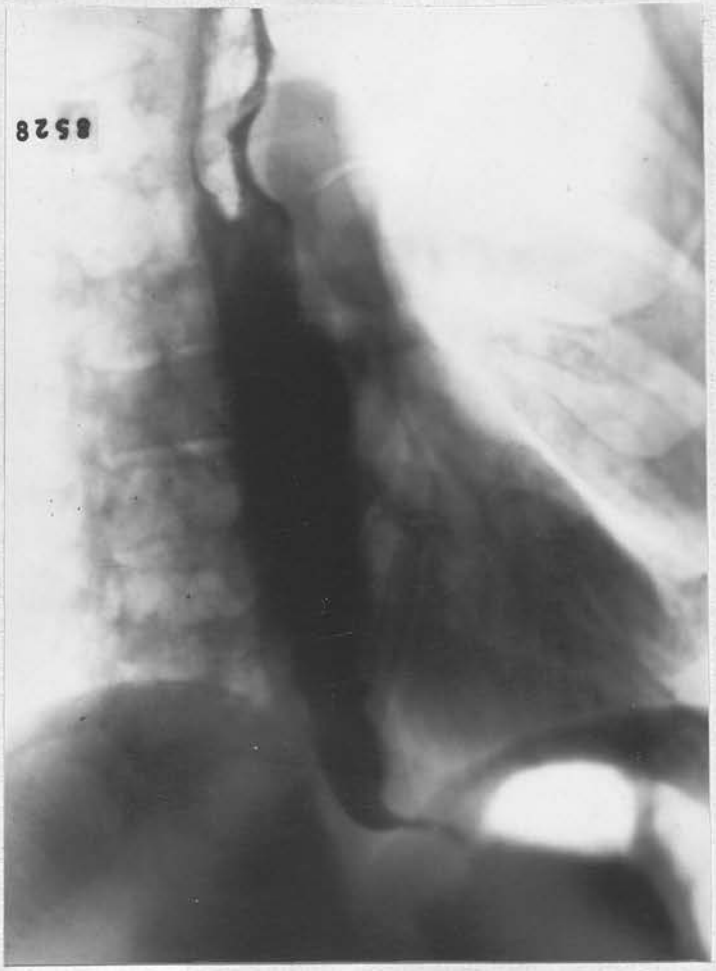

Plate (9).

H.H. Male. Age 57.

Spasm due to Peptic Ulcer.

The radiograph shows a condition of spasm immediately above the cardiac orifice, with several peristaltic waves above this point.

SIMPLE TUMOURS OF THE OESOPHAGUS.

(1) Pedunculated Tumours or Polypi.

(2) Sessile Tumours.

Polypi may arise primarily in the pharynx and hang down into the oesophagus, or they may arise from its anterior wall. They are not as a rule large, seldom being larger than a walnut. The pedicle may be long or short.

Histologically, a polypus may be a fibroma, lipoma, myoma or a simple mixed tumour.

They generally occur late in life, and cause increasing dysphagia.

The patient may have a sensation of a foreign body in the gullet.

Sessile tumours occur and, if of the papillomatous variety, may give rise to dysphagia.

Neither of these types of tumour give any characteristic X-Ray appearances, the radiological examination being mainly of use in excluding other conditions. The diagnosis is made by direct examination.

A.J.Hall (I). reports a case of a girl of I7 who developed progressively increasing dysphagia, with cough and wasting. The X-Ray examination showed an extensive foreign mass occupying the posterior mediastinum, and oesophageal obstruction. At the post-mortem/

post-mortem examination the whole oesophagus was found to be enormously thickened and dilated. Histological examination showed that there was a diffuse fibro-myoma occupying the position of the circular muscular coat.

(I). "A Case of Diffuse Fibro-Myoma of the Oesophagus causing Dysphagia and Death."

Arthur J. Hall M.D.,F.R.C.P. Quart. Jour. Med. Vol. 9. No. 36. July I9I6.

SARCOMA.

Sarcoma of the oesophagus is a relatively rare condition.

C.E. Smith and G.Y. Rusk in an article entitled "Primary Sarcoma of the Oesophagus", published in the Annals of Surgery, Nov. 1923. p. 577., state that at that time only 35 cases had been described in the literature. They give the following analysis of the cases:

The average age of the patients was 53.6., and where the sex was given, 26 were men, and 7 women.

In 24 cases the tumour occurred in the lower half of the oesophagus, in 8 in the upper half, and in one case in the middle. In two cases the growth involved the middle and lower part.

In 14 cases the growth was polypoid, in 12 it was nodular and diffuse, and in 9 annular. Many in the two last groups showed ulceration.

Classified according to the type of cells present, 11 were spindle celled, 7 mixed spindle and round celled, 5 round celled, 5 myosarcomata, 2 melanosarcomata, 1 lymphosarcoma, 1 lyphangioendothelioma, 1 endothelial sarcoma, 1 carcinoma-sarcomatodes, and one in which the type was not stated.

Unlike sarcoma in other situations, it is not a disease of young people, but occurs in individuals over forty years of age, thus resembling carcinoma.

The most common situation is in the lower

third of the oesophagus, or near the cardia.

The growth may be circumscribed, polypoid, or may be a widely infiltrating type. It tends to break down and ulcerate.

Histologically, the growth may be of the spindle celled, round celled or melanotic variety.
The symptoms are like those of carcinoma, but dysphagia may appear early, and is gradually progressive. Blood and pus may be brought up, and pain is apt to be a feature. It may be located between the scapulae and so resemble that of aneurysm.
Cachexia is usually pronounced, and may appear somewhat early.
Radiological Findings: The screen examination will usually show the shadow of a foreign mass in the posterior mediastinum. The barium shows the position and extent of the lesion, but it is not possible to differentiate the condition from carcinoma by radiological examination alone. If the tumour is of the fungating type, the irregularity of the filling defect is apt to be very great, in fact more so than is usual with carcinoma. At the same time, there is frequently comparatively little obstruction, for the disease tends to confine itself to one side of the wall of the oesophagus for a long time.
In the example illustrated (Plate IO), the foreign shadow surrounding the oesophagus, the extreme irregularity of the filling defect, and the slight degree of the obstruction are all well seen.

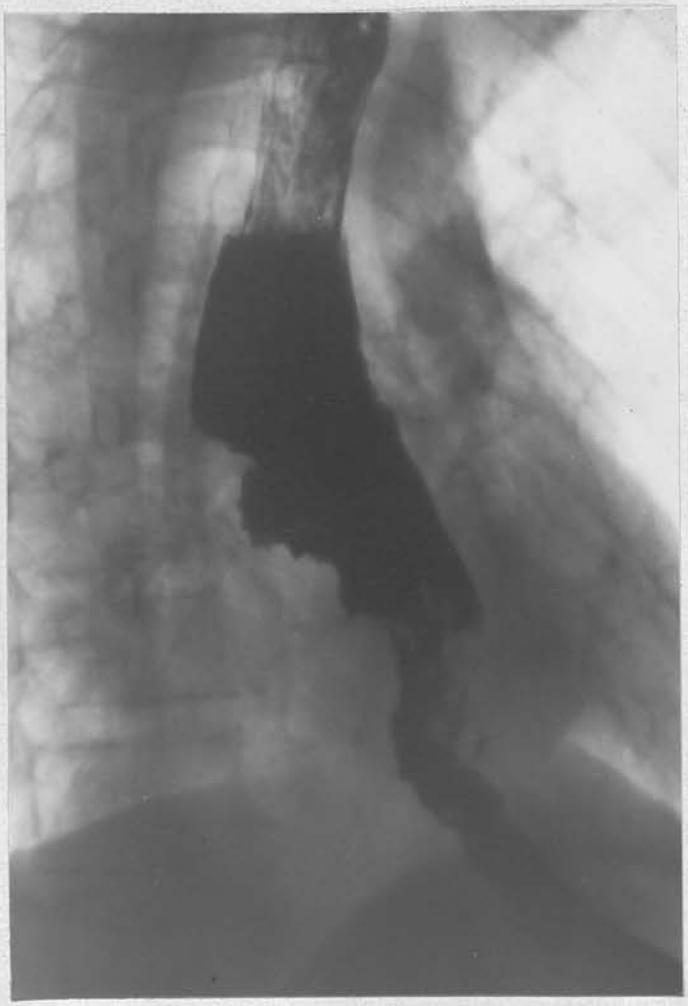

Plate (IO).

Wm. Mc. C. Age 46.

Sarcoma.

History: About one year ago, began to experience pain and a feeling of tightness across the chest when swallowing food. It felt as though the food got stuck somewhere. Has lost 3 St. in the year, and feels very weak. Wassermann reaction negative.

X-Ray Examination showed a very gross filling defect involving especially the posterior wall of the oesophagus in its mid portion. No real obstruction. Extensive foreign shadow in the posterior mediastinum corresponding to this filling defect. The appear

-ances suggest invasion of the oesophageal wall by an extrinsic mediastinal neoplasm.

In addition, all the long bones show the fringing with sub-periosteal new bone which is typical of the condition known as Hypertrophic Pulmonary Osteo-Arthropathy.

Post Mortem Report: Sarcoma of mediastinum involving, but not obstructing, the oesophagus.

CARCINOMA.

Carcinoma of the oesophagus is not a rare condition and occurs very much more frequently than all other tumours of the gullet put together.

It is very much more frequent in men than in women, 75% of the cases seen being in males. (Krauss).

The disease is commonest about the age of fifty, but cases have been reported at the age of ninety years, and Heimann reports one in a girl under nineteen.

The disease is usually primary, but the oesophagus may be involved by extension downwards from the pharynx or larynx, or upwards from the cardiac end of the stomach. It is commonly stated that the sites of predilection are the three chief anatomical narrowings, i.e., at the level of the cricoid, at the bifurcation of the trachea and at the cardia.

Demel's figures are as follows:

In the upper third	12'3%
At the level of the bifurcation of the trachea	60'8%
Lower third.	8'9%
Above the cardia..	18%

These figures do not agree with the records of cases examined in the Radiological Department of the Royal Infirmary, Edinburgh, which would suggest that the greatest/

greatest proportion of cases occurs in the lower third, well below the bifurcation of the trachea.

In females, the post-cricoid situation is the most common.

Histologically, the tumour has usually the structure of a squamous epithelioma, but adeno-carcinomata also occur. A rare form of oesophageal malignancy is the carcino-sarcoma. This tumour is frequently pedunculated, and springs from the anterior oesophageal wall. An example of this tumour, diagnosed radiologically, is very fully reported by A. Rosselet and E. Schintz (Schweizer. Med. Wochenschrift. 1924. Nr. 44.).

Carcinoma may take the following forms:-

(1) A flat, infiltrating ulcer.

(2) A polypoid or irregularly globular mass.

(3) Rarely, a diffuse infiltration.

If the interstitial connective tissue is highly developed, the growth takes a scirrhus form which causes obstruction earlier than do the soft varieties.

At first, the surface of the tumour may be smooth, but later villi, papillae, or fungating masses are formed, and the mucous membrane breaks down, forming an ulcer.

The ulcer may encircle the tube, causing constriction. The tumour continues to invade the tissues more and more deeply, and frequently involves the/

the peri-oesophageal structures. The local lymph glands are invaded, causing a shadow in the posterior mediastinum which may be seen on fluoroscopy, before the barium is given.

The disease may invade the trachea, causing a tracheo-oesophageal fistula. When this happens, the first mouthful of barium will at once enter and outline the trachea and main bronchi, and will also excite violent coughing.

More distant glands may be infiltrated, depending upon the situation of the growth; the lower cervical glands being involved in carcinomata of the upper end, and the mediastinal glands when the disease is in the mid or lower portions.

Symptoms:

In many cases the disease is entirely latent for a considerable period, difficulty in swallowing being the first symptom, but there may be prodromal sensations of discomfort or fullness behind the lower end of the sternum, which may or may not be related to food. Actual pain is very rare in the earlier stages, and may be absent throughout most of the course of the disease.

The patient may find that he has to chew his food more carefully than before, or that he has to take large draughts of fluids with his meals in order to wash the food down, and to get rid of the feeling of fullness.

There/

There may be vague dyspeptic symptoms, and some patients are treated for considerable periods for supposed "gastritis".

A very small lesion may by its irritation cause reflex spasm, in which case marked dysphagia may ensue long before there is any actual mechanical obstruction from the size of the growth.

As the tumour increases in size and begins to encircle the gullet, the dysphagia becomes increasingly severe. At first the difficulty is with solid food, but it is progressive and sooner or later there is difficulty with fluids also.

There is an anomalous type in which the dysphagia appears to be of sudden onset, the patient even dating the trouble from a particular meal, at which especially large morsels may have been swallowed. In these cases, there is a large element of spasm in the production of the dysphagia. Again, a patient with slowly increasing dysphagia may suddenly experience complete obstruction, due to the development of acute spasm.

When the prodromal symptoms have been present for a longer or a shorter time, regurgitation, or the so-called "oesophageal vomiting" begins. At first there is regurgitation of occasional mouthfuls of food soon after meals, without any real nausea or appreciable discomfort. The food is returned practi-

cally/

practically unaltered, and does not contain free HCl.

Later, when the obstruction is more complete and there may be a certain amount of dilatation, the regurgitation tends to become more profuse, and to more nearly resemble true vomiting. The material returned may be mixed with mucus, pus or blood, and in the later stages, may be very foetid.

Another common symptom is increased salivation.

Wasting is a very pronounced feature. It is proportional to the severity of the obstruction, and is due both to the starvation and to loss of fluid, and to some degree also to toxaemia resulting from the breaking down of the tumour. It may develop very rapidly, the patient losing many pounds in a few months.

There is not the profound distaste for food which is seen in gastric carcinoma; the trouble is rather that the patient cannot get the food down.

When a considerable area of ulceration has developed, there may be some pain of a burning character, when food passes over it, but real pain does not usually occur until there is some involvement of the peri-oesophageal structures, especially nerves, In that case it is felt chiefly between the scapulae and in the back of the neck.

Hoarseness, from pressure on the recurrent laryngeal nerve may be a very early symptom, even appearing/

appearing before there are any signs of obstruction. Later, there may be paralysis of the nerve, usually the left, from its involvement in the tumour.

Radiological Examination:

Owing to the insidious onset of the disease, it is usually well developed before the patient is sent for examination, and the findings are therefore apt to be very definite. The patient should be examined in the oblique position before any barium is given.

The tumour itself, or the mediastinal glands which it has invaded, may cause a dense foreign shadow in the posterior mediastinum. In rare instances, this mass may be of such size and density as to be mistaken for an aneurysm.

When barium is given, the appearances will vary with the type of growth which is present.

The flat infiltrating ulcer causes a filling defect in the outline of the oesophageal lumen, corresponding in extent to that of the growth. An example of this type of growth is the case of J.T. (Plate 11). Here, there is a long filling defect of the anterior wall of the gullet, with a foreign shadow outside that of the barium, due to the actual tumour mass in the mediastinum.

The commonest type of carcinoma from the radiological point of view is a somewhat more fungating type, occurring in the mid third of the oesophagus. It/

It usually has a sharply defined upper margin, with a very irregular rat-tail prolongation leading downwards from it. In these cases there is usually considerable dilatation above. (Cases A.S. and T.M. Plates 12 and 13).

Carcinoma of the epicardial oesophagus: This may be best seen with the patient lying supine, especially if he is told to make several successive swallowing movements, which have the effect of allowing regurgitation of barium from the stomach into the lower end of the oesophagus. In these cases there may be some involvement of the fundus or lesser curvature of the stomach as well.
(Cases: Mrs.F., A.A., A.R. and W.D. Plates 14-18)

When a patient gives a history suggestive of cancer of the gullet, and nothing is found in the oesophagus on X-Ray examination, it is of the greatest importance to examine the cardiac end of the stomach in the supine position, since a carcinoma there may give purely oesophageal symptoms. The case of W.I. (Plate 19) is given to illustrate this point. This man gave a history simply of dysphagia with solids and wasting. Nothing was found in the gullet, but there was an extensive carcinoma of the fundus.

Post-Cricoid Stricture: Here the growth tends to be of a scirrhus type, and to produce a ring stricture/

stricture, Very early cases are prone to be missed, unless dry bread crumbs are mixed with the barium, in order to elicit any spasm which may occur reflexly when the surface of the growth is irritated by the passage over it of rough food. (Case C.M. Plates 20 and 21).

There is usually some very slight dilatation of the hypopharynx, but occasionally this may be marked, as in the case of J.H. (Plate 22). In this case, oesophagoscopy showed very little actual organic obstruction, most of it being the result of associated spasm.

Plate (II).

J.T. Male. Age 65.

Infiltrating Carcinoma.

History: Difficulty in swallowing, especially solid food, for 6 weeks. Hoarseness which comes and goes.

X-Ray Report. There is a foreign shadow in the posterior mediastinum below the aortic arch. At the same level, the oesphageal lumen was very irregular for some 3 to 4 inches, and there was considerable obstruction to the passage of thick barium, with some dilatation above. The appearances suggest an extensive malignant infiltration of the oesophagus.

Endoscopy. (Dr. J.S. Fraser.)

" At a distance of 22 cm. from the gum of the up-

per jaw a yellowish pink fungating growth was seen apparently on the anterior wall of the gullet. Pieces removed and sent for report."

Pathological Report: " The tissue examined shows the deep invasion of a fairly widespread squamous epithelioma."

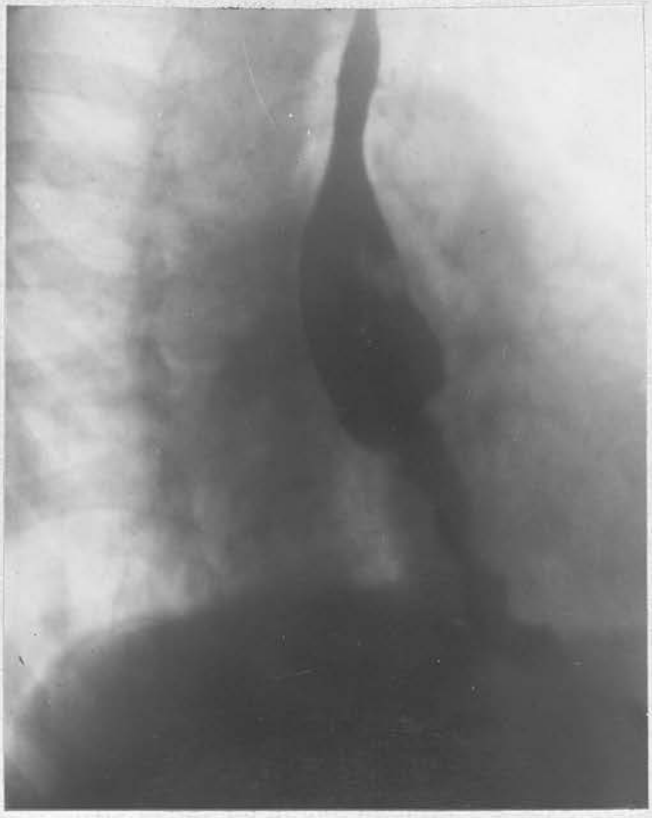

Plate (I2).

A.S. Male. Age 65.

Carcinoma.

Complaint: Difficulty in swallowing, especially with solid food.

Radiological Examination: The preliminary screen examination showed a dense foreign shadow in the posterior mediastinum, suggestive of the presence of some new growth. On giving barium, a long, very irregular stricture of the lower end of the oesophagus was found, corresponding in level to this shadow. The stricture shows the typical ragged outlines of carcinoma, and there is considerable dilatation of the oesophagus above it.

Plate (13).

T.M. Male. Age 54.

Carcinoma.

Complaint: Four month's history of pain in epigastric region immediately after food, and loss of weight. One week before examination, he began to have vomiting after every meal. Was sent for barium examination of the stomach.

X-Ray Report: There is a stricture just below the bifurcation of the trachea, with considerable obstruction. The typical irregularity of a carcinomatous stricture is in evidence. The stomach was filled, and appeared to be radiologically normal.

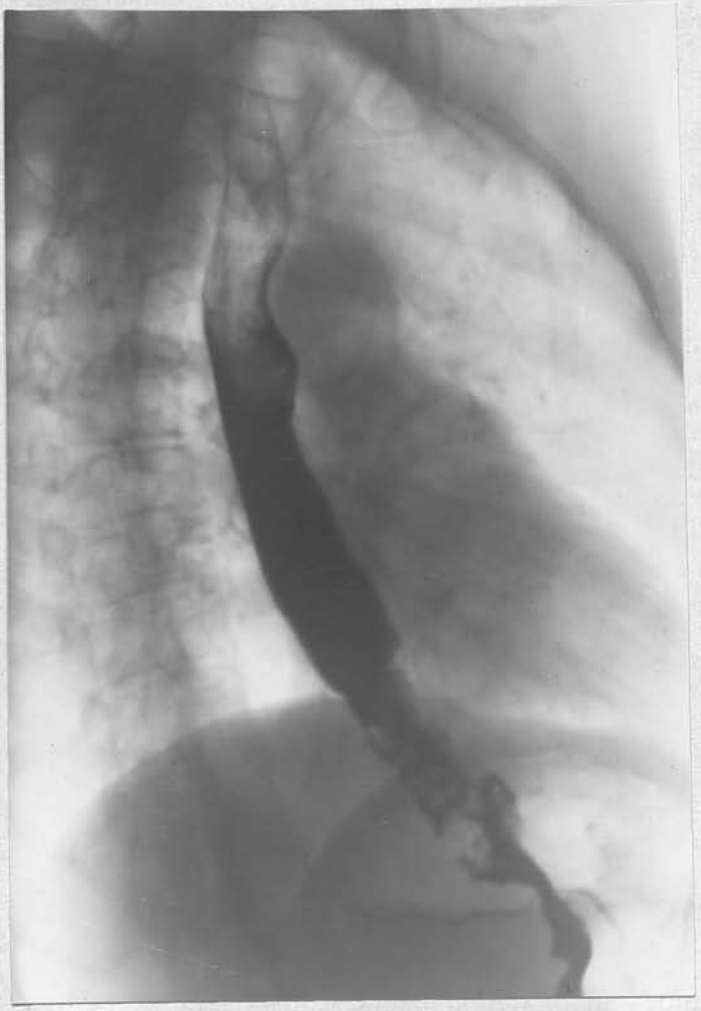

Plate (I4).

Mrs. F. Age 57.

Carcinoma of Epicardia and Fundus of Stomach

History: The patient was quite well until one year ago, when she began to have pain in the epigastrium, somewhat to the left side, and at times radiating upwards towards the left breast. No vomiting. Occasional sensation of momentary choking. Has lost 2 St. in weight in the year. Test meal shows Achlorhydria.

X-Ray Examination demonstrated a partial stricture, with gross irregularity of the epicardial portion of the oesophagus. This filling defect

was constant throughout the examination, and involved also some 3 inches of the proximal portion of the lesser curvature of the stomach. The appearances are those of carcinoma of the fundus and epicardia.

Plate (I5).

Mrs. F. Age 57.

Anterior Radiograph.

This radiograph shows the characteristic irregularity of the epicardia and fundus.

Plate (I6).

A.A. Male. Age 6I.

Carcinoma of Fundus and Epicardia.

History: Gastric pain and loss of weight for four months.

X-Ray Examination showed a somewhat dilated oesophagus, with a constriction at its lower end, and a definite filling defect at the cardia through which a thin stream of barium was passing. This filling defect extended down the proximal portion of the lesser curvature for about 3". The appearances are typical of new growth of the epicardial oesophagus and cardiac end of the stomach.

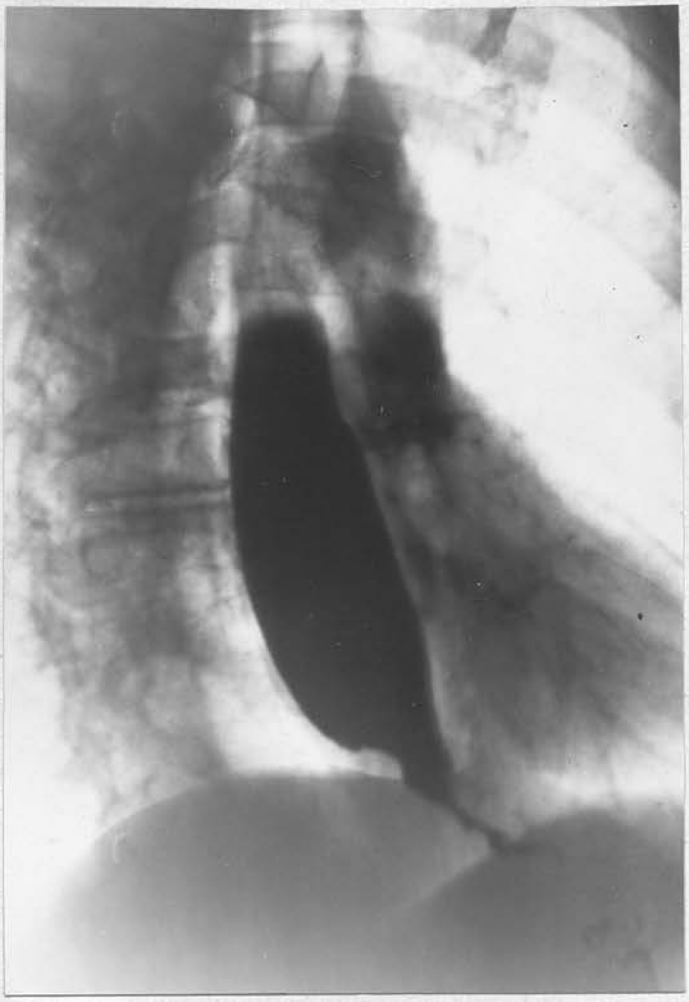

Plate (17).

A.R. Male. Age 49.

Carcinoma.

History: For the last 2 to 3 years the patient has had attacks, lasting for from 2 to 3 weeks, of regurgitation of mouthfuls of food, without real sickness or pain. Long intervals, up to one year, between the attacks. He gives the duration of his present illness as 3 months. For that period he has pain in the pit of the stomach and passing up under the right ribs, and also felt at times between the scapulae. The pain, which is of daily occurence, begins directly after swallowing food, especially

solid food such as meat. It is relieved by eructation. Failing this, it continues until he "vomits". The regurgitation at times takes place even before the meal is finished. For the last 3 weeks he has subsisted entirely upon a milk diet. Loss of weight and asthenia.

X-Ray Examination: There is a filling defect immediately above the cardia, with considerable obtruction to the passage of thick barium paste, and considerable dilatation above the stricture. The appearances suggest a malignant stricture.

Operation: The stomach appeared to be healthy, but there was an extensive carcinoma of the lower end of the oesophagus, with considerable glandular involvement. One nodule on the under surface of the liver, and two small metastases upon the posterior surface of the bladder.

Plate (I8).

W.D. Male. Age 65.

Carcinoma.

History: For the last 4 months, patient has felt that food was arrested at the lower end of the oesophagus. There was often also pain behind the lower end of the sternum, immediately after food had been swallowed. This was frequently followed by regurgitation of the food, which at once relieved the pain. There has been very marked loss of weight. The patient was referred for examination of the stomach.

X-Ray Examination: There is a stricture just above the diaphragm, showing the typical irregular-ity of carcinoma. Obstruction is very marked, and there is some dilatation of the oesophagus above the stricture. Very little barium food entered the stomach, but the viscus appeared to be normal.

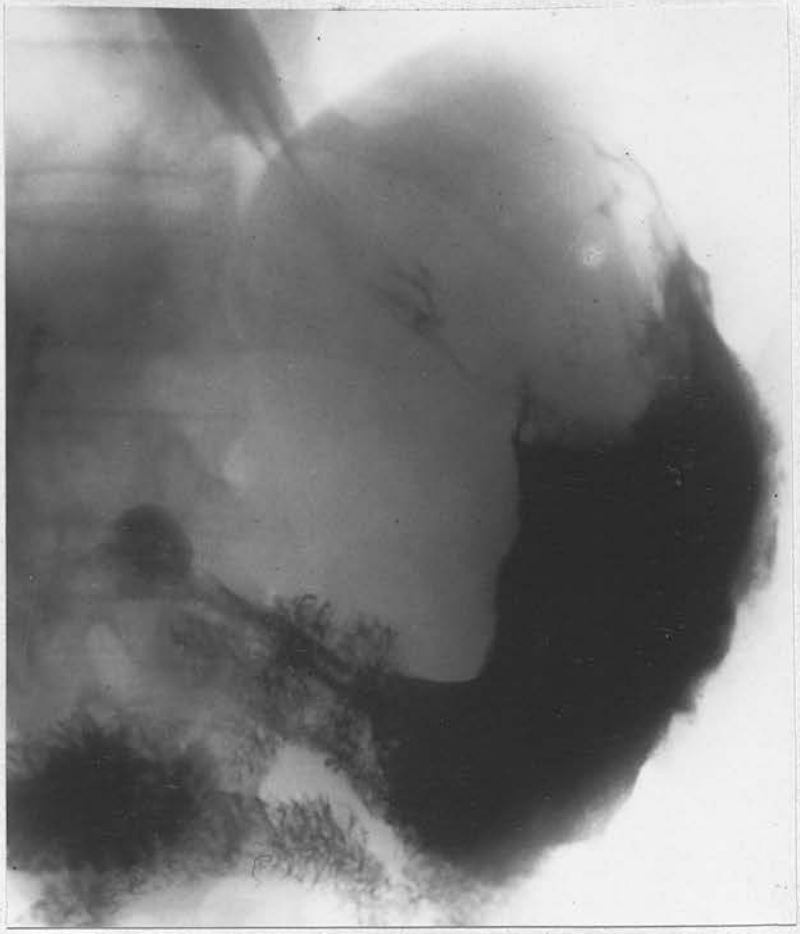

Plate (19).

W.I. Male. Age 57.

Carcinoma of Cardia.

Complaint: Dysphagia, especially with solids.

Clinical Diagnosis: ? Malignant oesophageal stricture.

X-Ray Examination: No evidence of any oesophageal obstruction or filling defect. The stomach was then filled with liquid barium and the patient examined in the supine position. There was a very extensive filling defect, involving the whole cardia and extending down upon the lesser curvature for some 3 inches. Conclusion: Extensive carcinoma of cardiac portion of stomach.

Plate (20).

C.M. Female. Age 62.

Post-Cricoid Stricture.

Complaint: Sensation of food sticking at the level of the cricoid cartilage.

X-Ray Report: There is a partial stricture at the level of the cricoid, with distinct dilatation of the oesophagus immediately above. There was definite obstruction with thick barium paste. The radiological appearances indicate a post-cricoid stricture, most probably an early carcinoma.

Plate (2I).

C.M. Female. Age 62.

Post-Cricoid Stricture.

The radiograph, in the anterior position, shows a stricture at the level of the cricoid, with distinct dilatation of the pharynx above. Obstruction was not evident with liquid barium, but was obvious on giving thick barium paste.

Endoscopic Report: (Dr. G. Ewart Martin.)

"Small carcinoma on the posterior wall of the oesophagus, at the level of the cricoid cartilage".

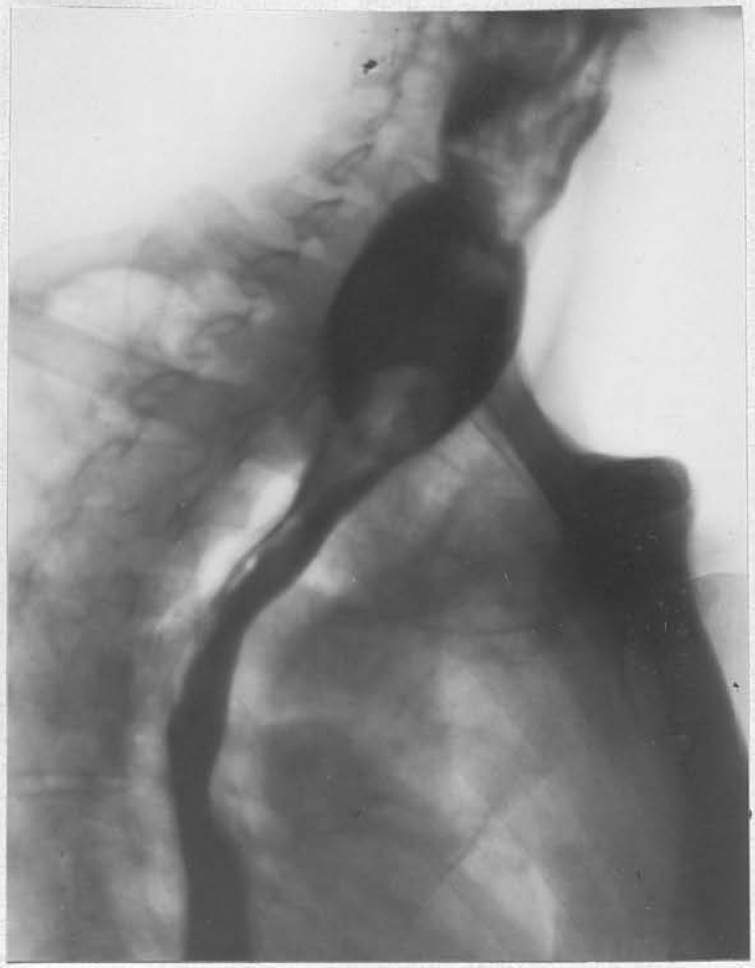

Plate (22).

J.H. Female. Age 31.

Ring Carcinoma.

Complaint: Difficulty in swallowing of two months' duration.

X-Ray Examination: The preliminary screen examination showed an ill-defined shadow in the posterior mediastinum at the level of the 2nd. and 3rd. dorsal vertebrae. The barium paste revealed a slight delay at the same point, with well-marked dilatation above. The food, however, passed down with little real obstruction. Dry bread crumbs were then given, followed by thick barium paste, which was now definitely held up for several minutes. The examination is suggestive of an

early carcinoma, but the dysphagia is probably due largely to spasm ,from the irritation of the lesion, rather than to actual organic stenosis.

Report on Endoscopic Examination.(Dr.J.S.Fraser.)

"There is a small ring carcinoma at the level of the 3rd. dorsal vertebra. The oesophagus is dilated above it, but there is very little organic obstruction."

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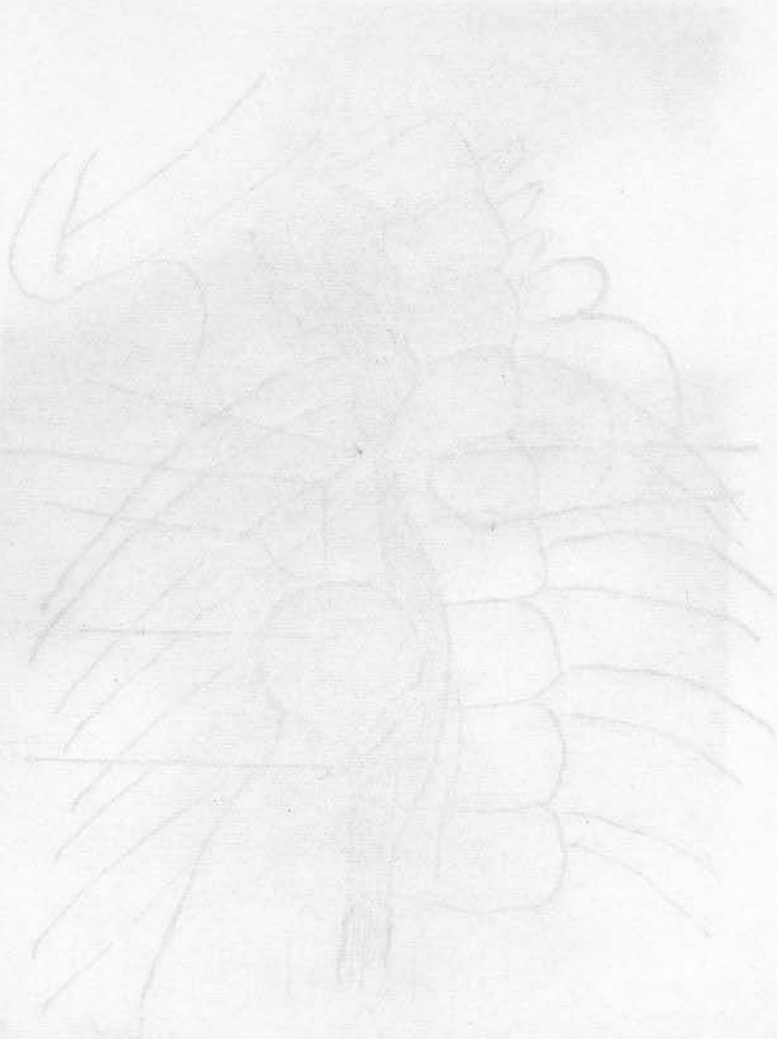
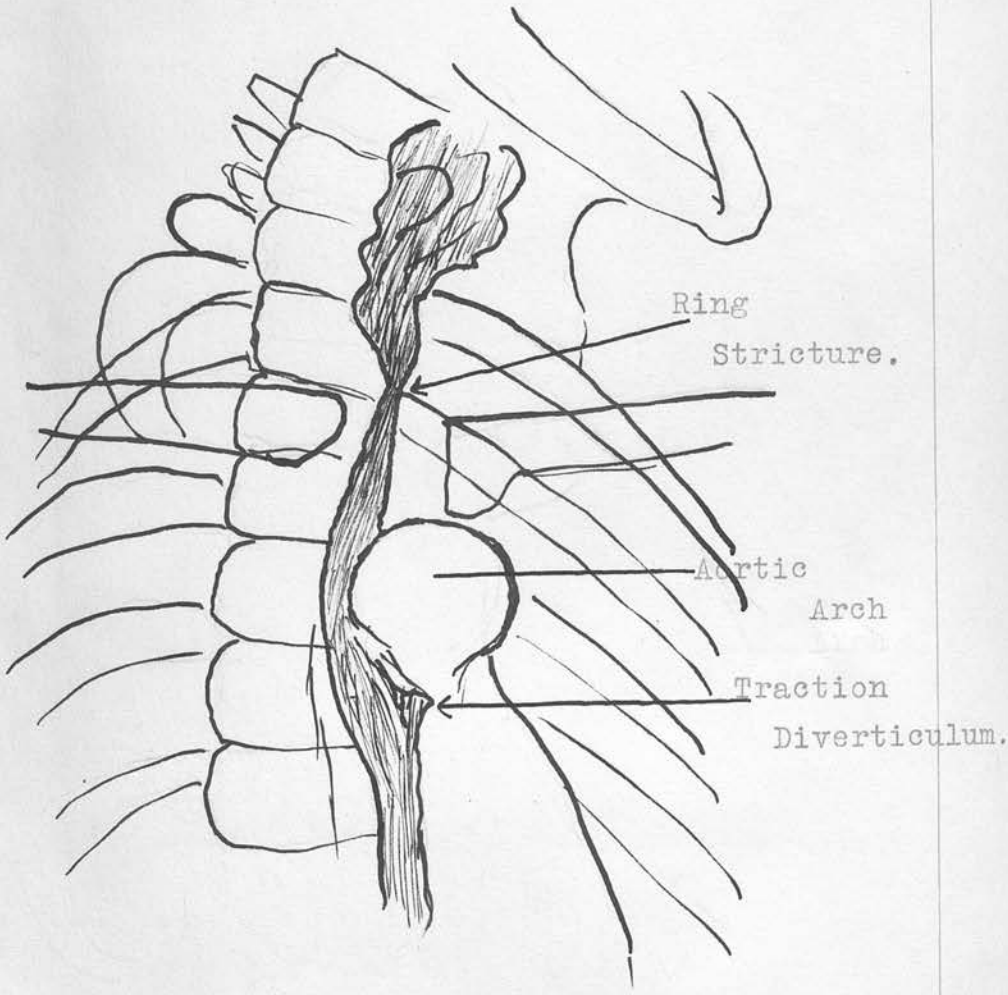




J.G.
Post-Cricoid Carcinoma and Traction Diverticulum.

Plate (23).

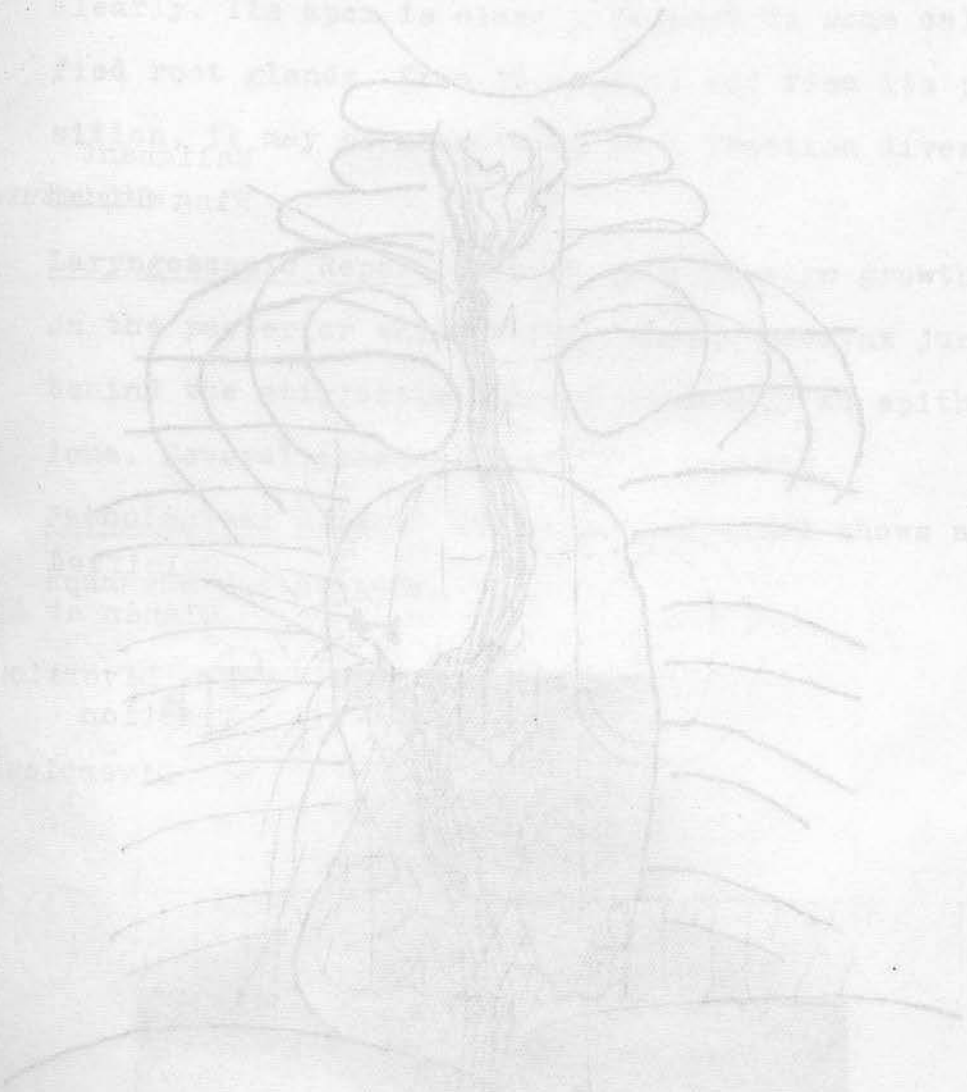
J. G. Female. Age 57.

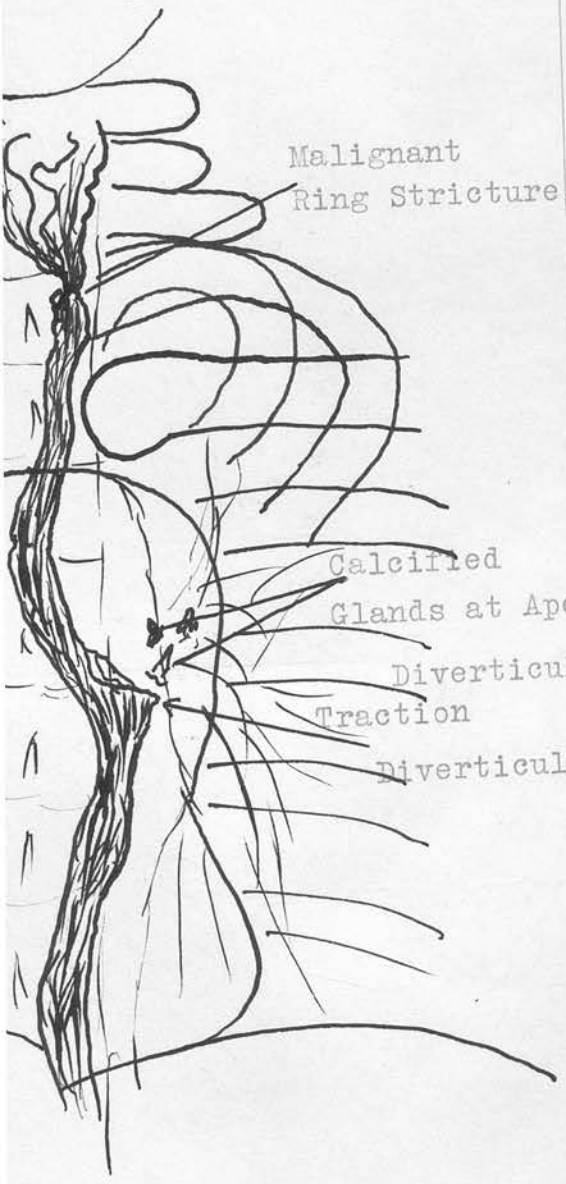
Post-Cricoid Carcinoma and Traction Diverticulum.

History: Hoarseness and pain in throat for two years. Can not swallow solid food. The pain shoots up to her ears. Patient has a cough, and for the last 2 months has been spitting blood. Loss of weight recently.

X-Ray Examination: There is a definite post cricoid stricture, with dilatation of the hypopharynx above it. The appearances indicate new growth. In addition, there is some dilatation of the descending aorta, and a small diverticulum upon the left lateral wall of the gullet, just below the aortic arch. The radiogram reproduced above is in the

To face page 83





ioma and Traction Diverticulum

right anterior oblique positi
an anterior view, shows the d
clearly. Its apex is closely
fied root glands. From this f
sition, it may be assumed to
iculum.

Laryngoscopic Report: There
on the posterior wall of the
behind the epiglottis. Almost
ioma. Several pieces removed

Pathological Report: The tiss
squamous epithelioma.

right anterior oblique position. That given below, an anterior view, shows the diverticulum very clearly. Its apex is closely related to some calcified root glands. From this fact, and from its position, it may be assumed to be a traction diverticulum.

Laryngoscopic Report: There is a foreign growth on the posterior wall of the laryngo-pharynx just behind the epiglottis. Almost certainly an epithelioma. Several pieces removed for section.

Pathological Report: The tissue examined shows a squamous epithelioma.

Plate (25).

J.S. Male. Age 53.

Carcinoma.

Complaint: Dysphagia, of eleven months duration.

X-Ray Report: There is an almost complete obstruct-ion just above the level of the aortic arch. The oesophagus is considerably dilated above the stricture, which is long, irregular and very tortuous. Thick barium paste was not able to pass the stricture, but on giving a drink of water, a little of the barium passed through.

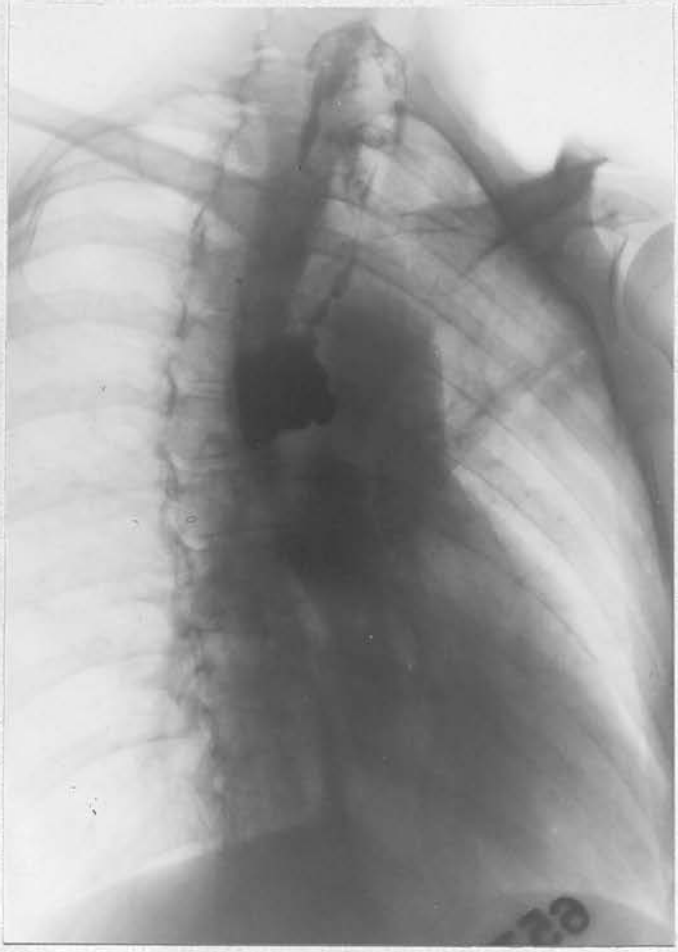


Plate (26).

Mrs. M.S. Age 60.

Carcinoma.

Complaint: Dysphagia, and loss of weight.

Radiological Examination: There was a definite obstruction at the level of the bifurcation of the trachea, with very marked delay in the passage of the barium. The oesophagus is dilated above the stricture. The appearances are those of an organic stricture, most probably carcinomatous.

Plate (27).

M. S. Female. Age 61.

Long-standing Carcinoma, after Gastrostomy.

The patient was first seen 16 months ago, when a partial stricture at the level of the bifurcation of the trachea was found. Oesophagoscopy showed a sessile growth on the posterior wall, biopsy proving this to be a squamous epithelioma. Gastrostomy performed.

The present radiological examination shows complete obstruction of the oesophagus, with considerable dilatation above the stricture. The lower pole of the stricture is singularly smooth and regular, being in this respect unlike most malignant strictures. The gastrostomy tube is seen in position.

PHARYNGEAL DIVERTICULUM.

Definition:

A pouch-like herniation of the oesophageal mucosa through the muscular layers of the posterior wall of the pharynx in the mid line, close to its junction with the oesophagus.

It has also been described as a "Pharyngocele", "Pulsion Diverticulum of the oesophagus", Pharyngo-oesophageal Diverticulum", "Grenz Diverticulum", and "Zenker's Diverticulum". The condition was first described in 1816 by Sir Charles Bell, (1) who also first suggested what is now believed to be the true explanation of its causation.

Pathological Anatomy:

The condition is a protrusion of the pharyngeal mucosa between the transverse and oblique fibres of the crico-pharyngeus muscle in the mid line posteriorly. This fact was first definitely established by Killian (2), and has been confirmed subsequently by Goldmann (2), Keith (3) and others.

As this pouch increases in size, it passes downwards behind the oesophagus and carotid sheath, tending towards one side or the other, most usually the left. It lies between the pre-tracheal and pre-vertebral layers of the cervical fascia. The downward sagging of the sac brings it into alignment with the/

the pharynx, the upper extremity of the oesophagus appearing as a narrow slit high up on the anterior wall of the pouch. Thus, food must pass directly into the sac, and must completely fill it before any can enter the oesophagus.

The pouch is lined with stratified squamous epithelium. There is a submucous coat, which may or may not show a muscularis mucosa. The outermost coat, derived from the pharyngeal fascia and connected with the submucosa by loose areolar tissue, is of very variable thickness.

Etiology:

No median pouch has been met with in this situation in the new-born, or in children, and there is no evidence that the condition is every congenital. It is most frequently met with in male subjects past middle life, being extremely rare in females. The diverticulum is essentially a hernia and is dependent upon some long standing cause of increased intra-pharyngeal pressure. Such an increase of pressure is conceivable, given some derangement of the normal reflexes of deglutition. While the action of swallowing is initiated voluntarily, it is, once begun, a complicated sequence of reflex actions. The oro-pharynx and naso-pharynx having been shut off by muscular contraction, respiration is inhibited, and the larynx drawn suddenly upwards and forwards, the food passing downwards and backwards towards the oesophageal/

oesophageal inlet.

Killian and Goldmann (2) have shown that the transverse fibres of the crico-pharyngeus act as a sphincter of the upper end of the oesophagus.

Wilkie and Hartley (4) have confirmed this observation, and have shown that this sphincter relaxes synchronously with the contraction of the pharyngeal wall and the elevation of the larynx in the act of deglutition. The relaxation of the sphincter is sudden and is followed by a slow contraction after a second or so. It is obvious that if, from some functional upset of the co-ordination of the reflex, this relaxation does not occur at the moment of pharyngeal contraction, then the intra-pharyngeal pressure will be raised, the constrictors of the pharynx forcing the bolus against the contracted sphincter. This pressure will be exerted against the interval between the transverse and oblique fibres of the crico-pharyngeus.

In the section on the anatomy of the oesophagus, the work of Birmingham on the arrangement of the muscle fibres at its upper end was summarised, and it was pointed out that there is a small triangular area on the posterior wall of the pharynx, above the transverse sphincteric fibres of the crico-pharyngeus and below the upper oblique decussating fibres of the inferior constrictor, which, not being covered by the longitudinal/

longitudinal fibres of the oesophagus and being only thinly covered by the circular fibres, constitutes a point of weakness in the posterior wall. (Fig.1. P.I9).

It is against this weak spot that the pressure of the pharyngeal constrictors is exerted, when the crico-pharyngeus fails to relax during the act of deglutition. Gradually, the wall in this triangular area gives way before the increased intra-pharyngeal pressure, and a hernia of the mucous membrane results.

When once the hernia has begun, its protrusion backwards draws the upper end of the gullet out of alignment with the pharynx, and when the sac is filled with food, it compresses the oesophagus and so causes still more obstruction. Thus a vicious circle is established, tending towards increasing dysphagia.

A considerable number of recorded cases have given a history of a slight difficulty in swallowing, extending over many years, such as might well be due to some functional inco-ordination of the reflex. A few cases have been recorded in which there was some organic stenosis of the upper end of the oesophagus, but this is rare.

Symptoms:

Many of these patients give a history of some difficulty in swallowing which has lasted for many years, often indeed from childhood. This initial difficulty is probably due to the functional nervous disability which precedes the formation of the pouch.

A/

A further evidence of neurosis is the fact that in some patients difficulty in swallowing is first complained of with certain specific articles of food, the physical qualities of which do not justify this special difficulty.

When the pouch has formed, the most characteristic sign is the regurgitation, a variable time after meals, of unaltered food material. There may be pronounced gurgling noises in the sac. As the pouch increases in size, feeding becomes progressively more difficult. At every meal the sac must be filled with food, before any of it can "spill over" into the oesophagus. Unless this process is carried out carefully and quietly, regurgitation may take place and the whole operation has to be begun over again. Once the pouch has been filled, the patient has to exercise great care in order to avoid regurgitation and to retain an adequate amount of food.

This regurgitation is often described by the patient as vomiting, but the food when brought up is unaltered and tastes as it did when first swallowed.

Another unpleasant symptom which may be present is an accumulation of saliva in the pharynx, especially at night.

In cases in which the pouch has attained a considerable size, the patient has usually to retire after the meal in order to empty it by inducing regurgitation/

regurgitation.

Radiological Examination:

The appearances are very striking, and enable an immediate and conclusive diagnosis to be made.

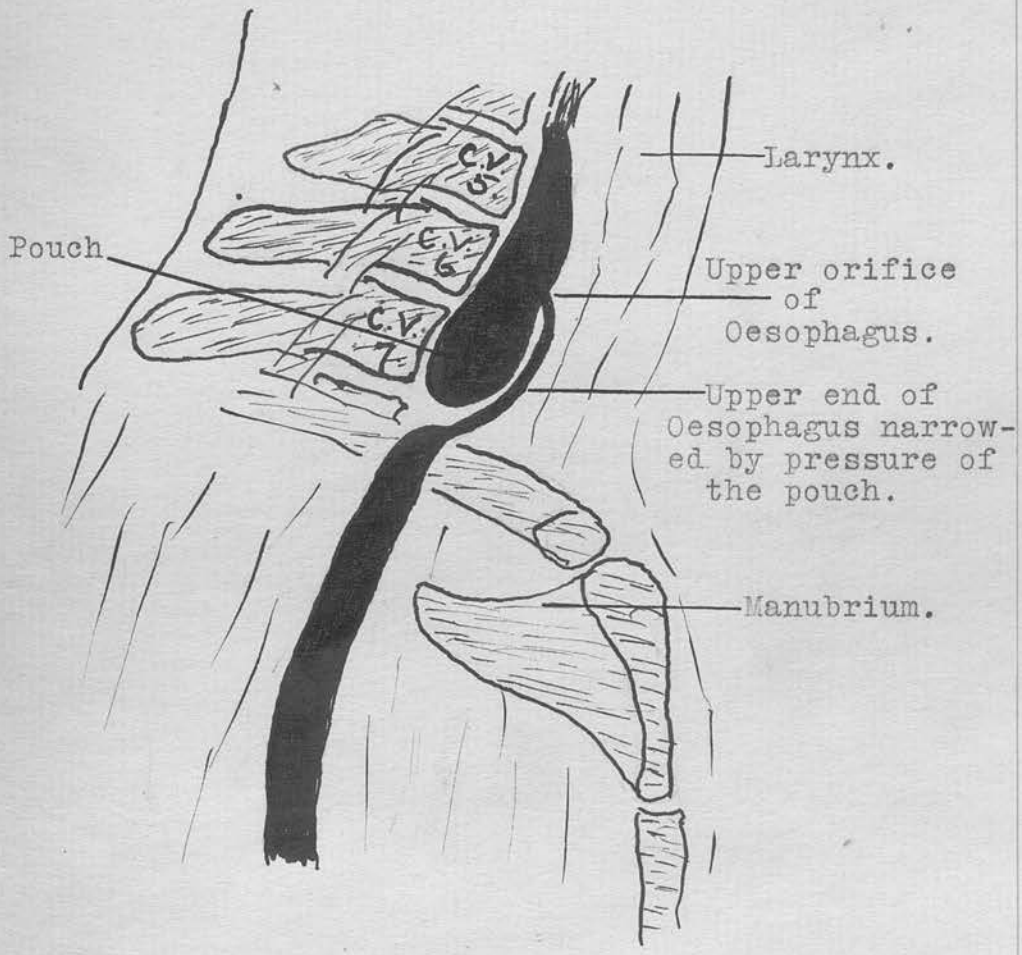
With the patient in the antero-posterior position, the appearance is that of a rounded dilatation of the oesophagus at the root of the neck. It may be as large as a duck's egg, and shows a perfectly smooth spherical lower pole.

Should there have been any solid food remnants in the sac before the Barium was swallowed, an apparent filling defect may be produced simulating at first sight that of carcinoma.

In the antero-posterior position the shadow of the barium in the pouch is superimposed upon that of the oesophagus, so that the food appears to be leaving by an opening at the lower pole, giving an appearance not wholly unlike that of benign stricture.

When, however, the patient is turned into the oblique position, the true condition is at once seen. The pouch is found to be lying behind the compressed and narrowed oesophagus, and when more barium is swallowed it is seen to enter the latter through a narrow slit-like opening high up on the anterior wall of the pouch. This is the typical radiological finding in a case of Pharyngeal Diverticulum. The diagram which follows is a tracing of a reduction from one of the/

the actual radiograms of the case Wm..C. which is described on the next page. The essential point in the radiological diagnosis is well seen, i.e. the fact that the barium overflows from a point high up on the anterior wall of the pouch, whereas in all strictures, it escapes from the lower pole of the pouch-like dilatation above the stricture.



Illustrative Cases:

Wm.C. (Male) Age 54. (Plates 28-32).

Complaint: Difficulty in swallowing, Regurgitation of food.

History: For over a year, patient has had difficulty in swallowing, especially with fluids. At first, this was only noticed occasionally, when he was hungry or excited. Gradually the difficulty has become more and more marked and, during the last few weeks, every mouthful of both solid and liquid food has been very difficult to get down. It appears to him as though the bolus is held up just after leaving the back of the tongue, and he has to make several efforts to get it down, usually resulting in a squelching sound. Sucking movements seem to help in the passage of the food from the mouth onwards.
For some months he has been troubled by periodic regurgitation of masticated food. This is usually food that has been taken at a meal the day before.
During the night within the last four months, patient has heard gurgling noises in his throat when he is in certain positions in bed. These occur even without making swallowing movements.

Previous History: Diphtheria twenty years ago. Appendicectomy five years ago. Five years ago had severe influenza, followed by persistent nasal catarrh with profuse post-nasal discharge which has continued until the present time. He thinks that this caused him to swallow frequently between meals.

The Radiological findings are given under the respective radiograms.

Endoscopic Examination (Mr. Lithgow): "The pouch is exactly as shown in the radiograms."

D.McL. (Male) Age 52. (Plates 33-34).

History: 1926: Became conscious of uncomfortable sensation/

sensation at entrance to throat, chiefly at end of meals and lasting one and a half to two hours. He describes this feeling as being as if there were a gap in the gullet, and this remained whether he were swallowing or not.
Six months later difficulty in swallowing - at first with meat, then later with such foods as potatoes and bread. No pain in the act.
Eighteen months later regurgitation of food into mouth one and a half to two hours after meal, consisting chiefly of the food of the last meal, and usually of those foods he had difficulty in getting down. Sometimes in the evening when bending over to wash, food would be regurgitated, and he has identified breakfast and lunch foods in the regurgitated material. Has gurgling sensations in the throat, but change of position often causes this to stop. He has found of late that he can produce these noises by pressing on the right side of his neck. He also has difficulty in beginning to speak, and wakens during the night to find his mouth full of saliva.

Previous History: Nil.

Examination: Rather poorly nourished.
Neck: On right side at level of upper border of the thyroid cartilage, there is a slight fullness interrupting the symmetrical contour of the neck and passing out obliquely, laterally and towards the anterior free margin of the sterno-mastoid. This fullness seems to rise with the larynx, the overlying skin remaining stationary, when the patient swallows, On pressing firmly over the lower third of the right sterno-mastoid after patient has swallowed a gurgling sound is produced.

Radiological Examination: The findings are given under the respective radiograms.

Plate (28).

Wm. C. Male. Age 54.

Pharyngeal Diverticulum.

Complaint: Dysphagia and regurgitation of food.

X-Ray Examination: There is a large pouch arising from the posterior wall of the pharynx, opposite the bodies of the 6th. and 7th. cervical vertebrae. The barium is seen entering the upper end of the oesophagus, which in the right anterior oblique appears as a narrow slit high up on the anterior wall of the pouch. The upper two inches of the oeso -phagus show marked antero-posterior compression of the lumen, resulting from the pressure of the

distended diverticulum lying behind it.

There is slight dilatation of the hypopharynx above the sac. It was noticed that no barium began to enter the upper end of the oesophagus until the pouch had been completely filled, when it began to "spill over" into the oesophagus.

The appearances are diagnostic of a well developed pharyngeal diverticulum.

Wm. C.

Anterior View.

29

Plate (30).

Wm. C.

Pharyngeal Diverticulum.

Plastic Print.

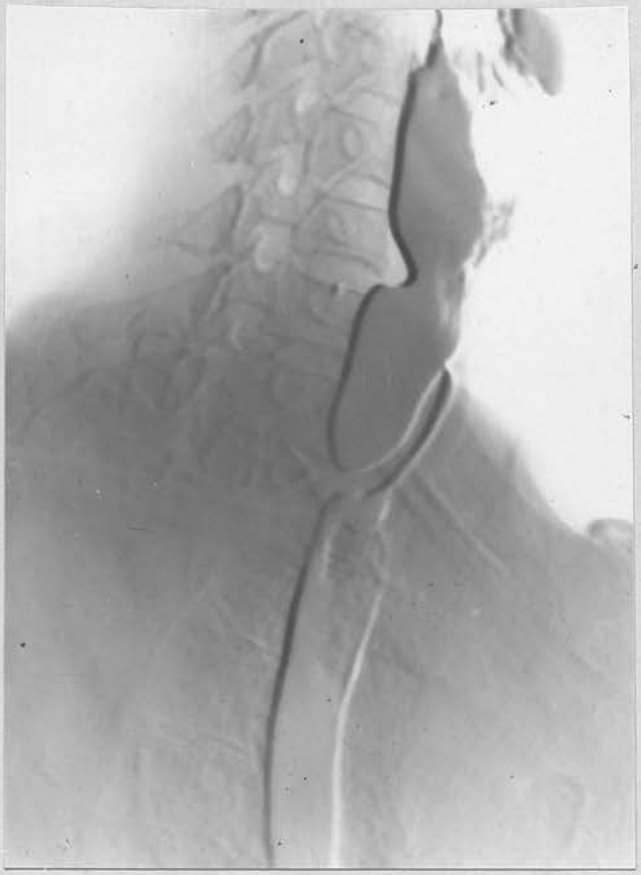


Plate (3I).

Wm. C.

Pharyngeal Diverticulum.

Plastic Print.

Plate (32).

D. Mc.L. Male. Age 52.

Pharyngeal Diverticulum

Complaint: Dysphagia.

X-Ray Examination: The screen examination showed a typical pharyngeal pouch. In the oblique position , the barium was seen to "spill over" from a point high up on the anterior wall of the pouch into the oesophagus, which was greatly narrowed by the pressure of the barium-distended sac.

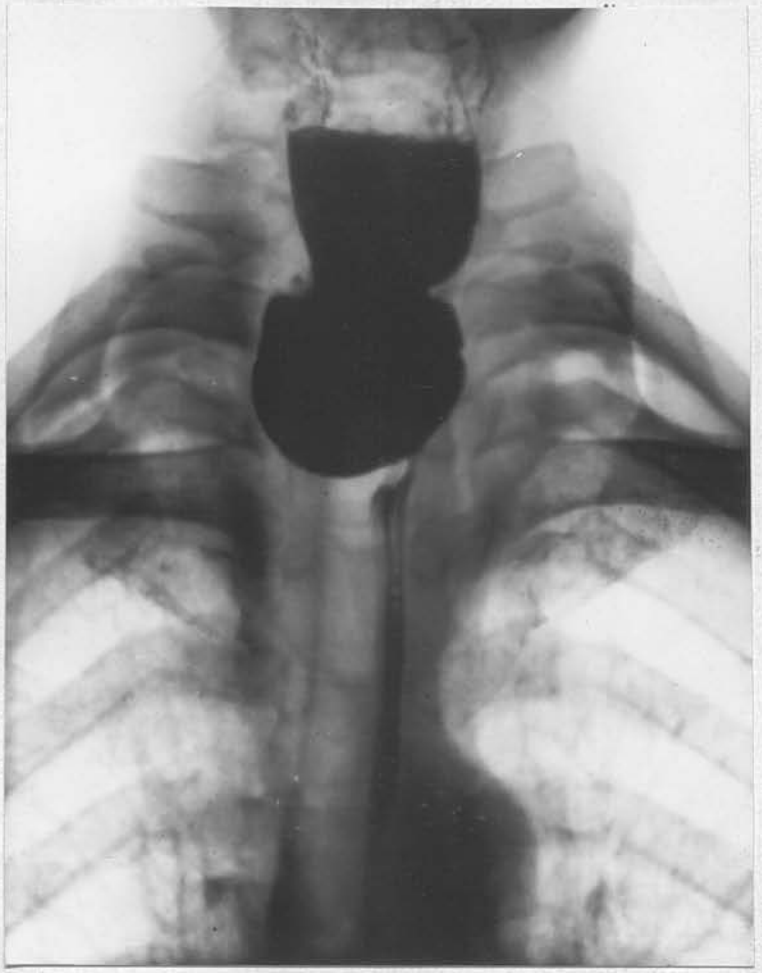


Plate (33).

D. Mc.L. Male. Age 52.

Pharyngeal Diverticulum.

Anterior Radiograph.

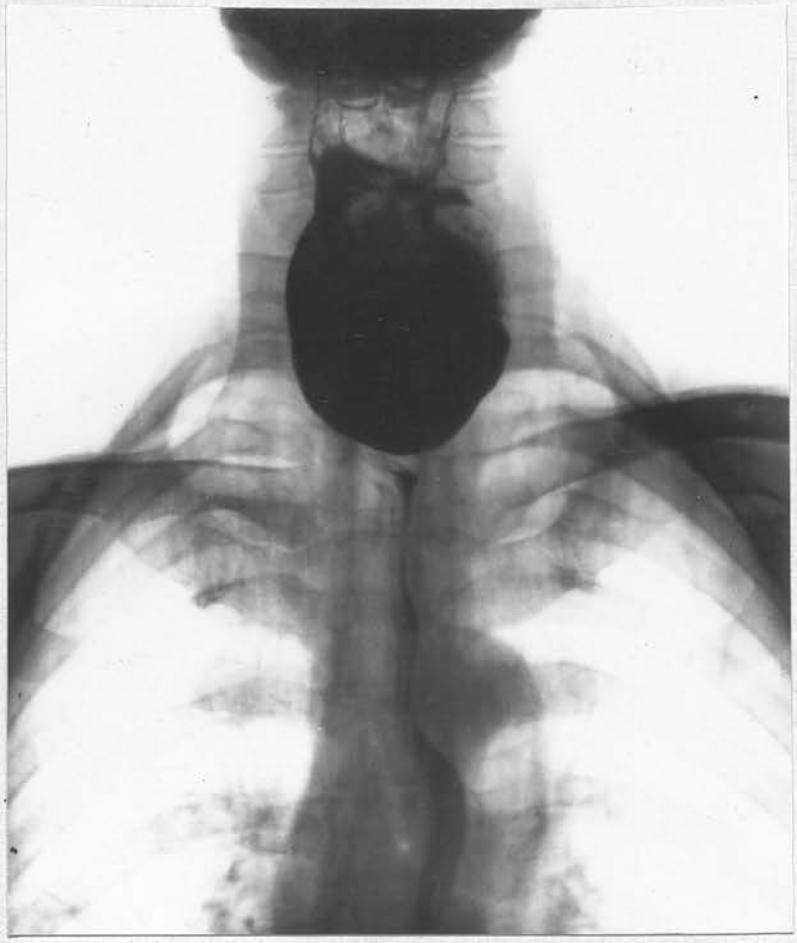


Plate (34).

S.S. Male. Age 70.

Pharyngeal Diverticulum.

Complaint: Increasing dysphagia of several years duration.

X-Ray Examination: The anterior radiograph shows a large dilatation in the line of the oesophagus below the cricoid region. The radiograph in the right anterior oblique position (overleaf) shows a very large pharyngeal diverticulum. The pouch can clearly be seen to lie behind the oesophagus, in the typical position of the pharyngeal pouch.

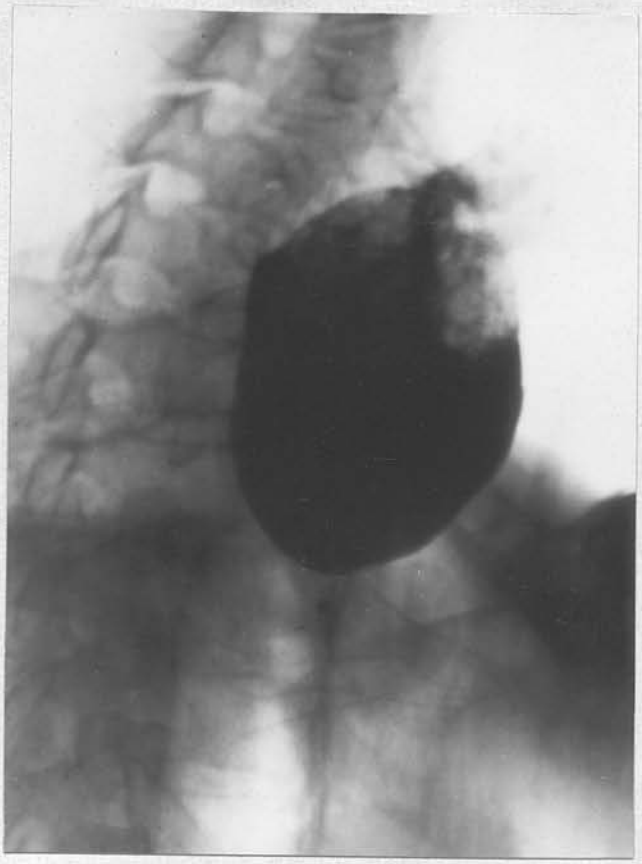


Plate (35).

S.S. Male. Age 70.

Pharyngeal Diverticulum.

Radiograph with patient in the right anterior oblique position.

REFERENCES.

(1) Charles Bell. Surgical Observations. 1816. Pt. 1. 67.

(2) E.E. Goldmann. Beit. 2. Klin. Chir LXl. 747.

(3) A. Keith. Brit. Med. Jour. 1919. Feb. 12th.

(4) D.P.D. Wilkie & J.N.J. Hartley Brit. Jour. Surg. 1922. Vol. X. No.37.

DIVERTICULA OF THE OESOPHAGUS.

Traction Diverticula:

Traction diverticula occur in the mid or lower portions of the oesophagus. They seldom attain a size greater than 1 to 2 cms. in length. They are never large, and are usually symptomless. They were first described by Rokitansky, and were named traction diverticula by Zenker.

The commonest site is just below the bifurcation of the trachea, and they are usually found on the anterior wall and towards the left side.

They are due to the traction of chronically inflamed lymphatic glands which have become adherent to the oesophagus.

Kragh examined 556 individuals post mortem, and found such adhesions in 14 cases, the glands showing early or late tubercular changes. In some of the cases, the oesophageal wall contained a cicatrix, the apex of which passed into an infected gland.

The diverticula are occasionally multiple.

The structure of the wall is variable. There may be simply a hernia of the mucosa, or all the layers may be involved. The apex consists mainly of fibrous tissue.

Chiefly seen in adults, especially males, they are usually symptomless, and unless spasm supervenes, they/

they are not likely to be found during life.

They are seldom found during radiological examination, as the barium does not always enter them. They are most likely to be found is the patient is examined with the foot of the couch raised.

Two examples of the condition are shown in this thesis. (Plates 25 and 36). In both these cases, the radiographs show calcified glands in close relation to the apex of a small diverticulum situated in the typical position, just below the bifurcation of the trachea. In one of the cases, (Plate 25), there was in addition to the diverticulum a post-cricoid carcinoma and a dilated descending aorta, but in the other one, (Plate 36), the traction diverticulum was the only oesophageal lesion found.

Pressure-Traction Diverticula:

This is a further stage of the simple traction diverticulum just described. Since these run horizontally or obliquely upwards, food does not usually enter them. In certain cases it does, however, When this happens, the pressure of the food causes some degree of enlargement of the sac, giving a pressure-traction diverticulum. Adhesions to adjacent structures limit the size of the sac, which always remains quite small, being usually the size of a hazel nut or smaller. The usual situation is the same as that of the simple traction variety; since they are both due to traction from inflamed glands which have become/

become adherent to the oesophageal wall, most commonly where the oesophagus is crossed by the left bronchus.

Simple Pulsion Diverticula:

This variety corresponds in structure to the pharyngeal diverticulum of Zenker, but is never found on the posterior wall. The site of election is on one lateral wall, usually the left, a little above the diaphragm.

The condition is a hernia of the mucosa through the muscular wall.

Brosch suggested that the point of origin is one of the minute foramina for the transmission of blood vessels and nerves which are found in the muscular wall of the gullet. This form of diverticulum is rather more common in men than in women, and is generally found in middle life or old age.

Diverticula arising above a stenosis are very rare as the thickening and muscular hypertrophy which ordinarily occur above reduce the possibility of diverticulum formation to a minimum. However, the condition does occur, as is shown by the case quoted below, and illustrated at the end of this section.

Radiological Appearances:

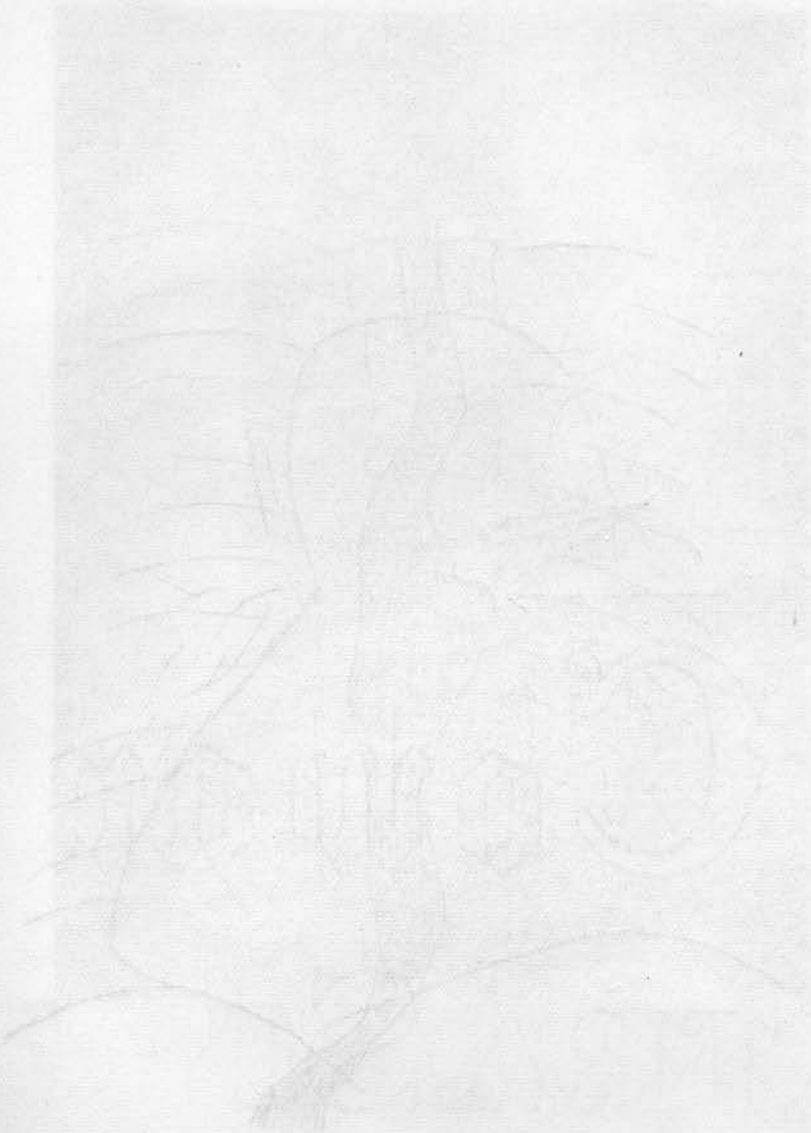
In pressure-traction diverticulum, the barium may enter and outline a small smooth-walled sac, projecting from the wall of the oesophagus, and usually directed/

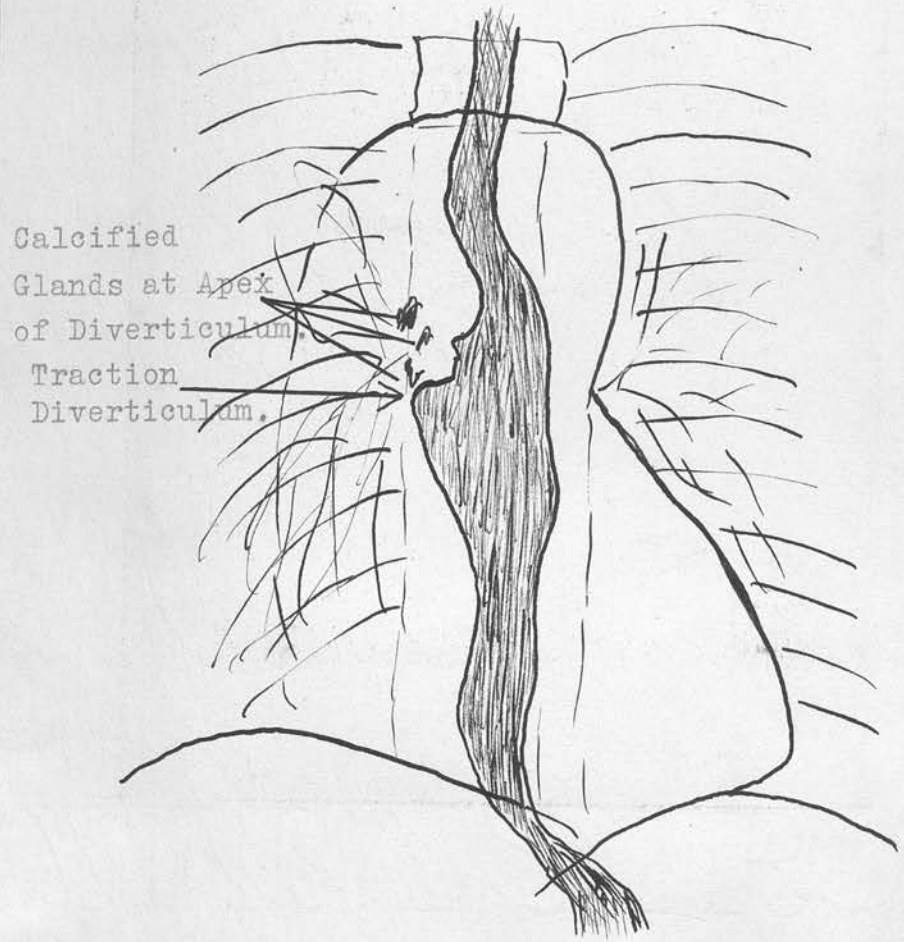
directed obliquely upwards. A film will in most cases show the fibrotic and probably calcified glands which are the cause of the diverticulum. The sac may not be filled unless the patient is examined in the recumbent posture.

In the diverticulum arising above a stenosis, the barium is seen to enter and outline a well defined lateral pouch, with smooth and regular walls. Unless the examination is made with the patient lying down, as well as erect, the primary stenosis may be found, but the pressure diverticulum missed.

The following case (Plate 37) is a good example of a pressure diverticulum arising above a stenosis, in this case a cardiospasm. With the patient erect, only the cardiospasm was seen, but when she lay down, the barium was seen to enter a very sharply defined sac springing from the right lateral wall of the oesophagus, one and a half inches above the cardia.

To face page 109.





Mrs. A.D.

Traction Diverticulum.

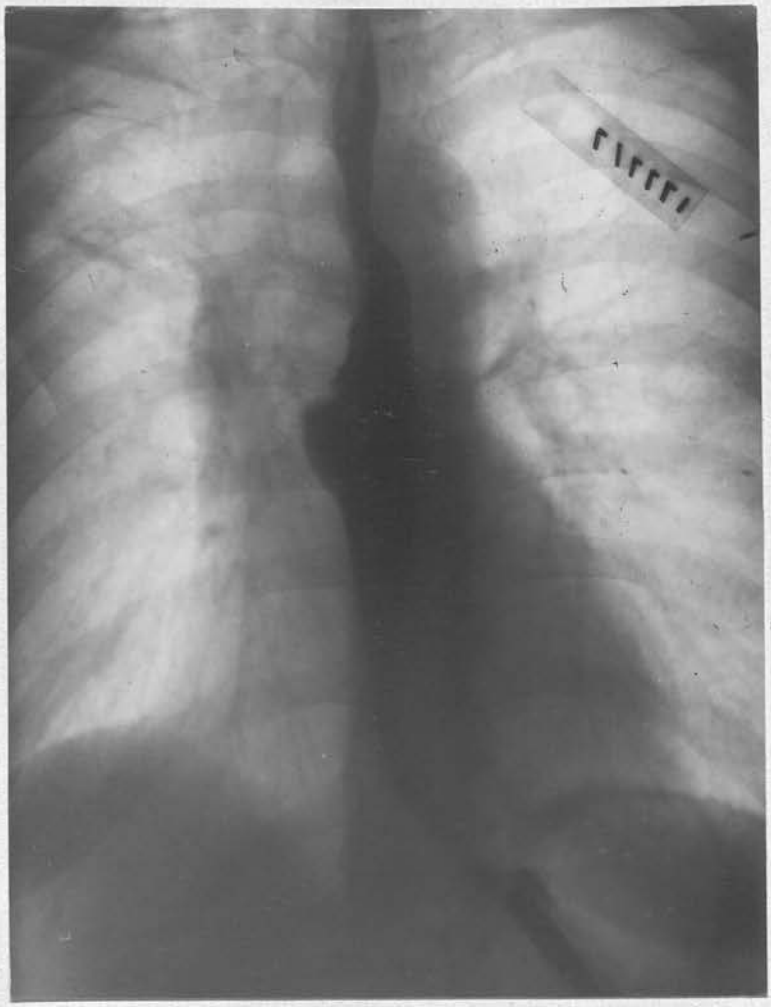


Plate (36).

Mrs. A.D. Age 48.

Traction Diverticulum.

This patient was sent for radiological examination of the chest. She complained of difficulty in swallowing of a year's duration, and of a feeling of food "sticking" in the oesophagus.

X-Ray examination showed a small diverticulum on the right wall of the oesophagus at the level of the lung roots. It is directed obliquely upwards, and a dense glandular shadow is seen at its apex. It presents the typical radiological appearances of a traction diverticulum due to an infected gland which has become adherent to the oesophagus.

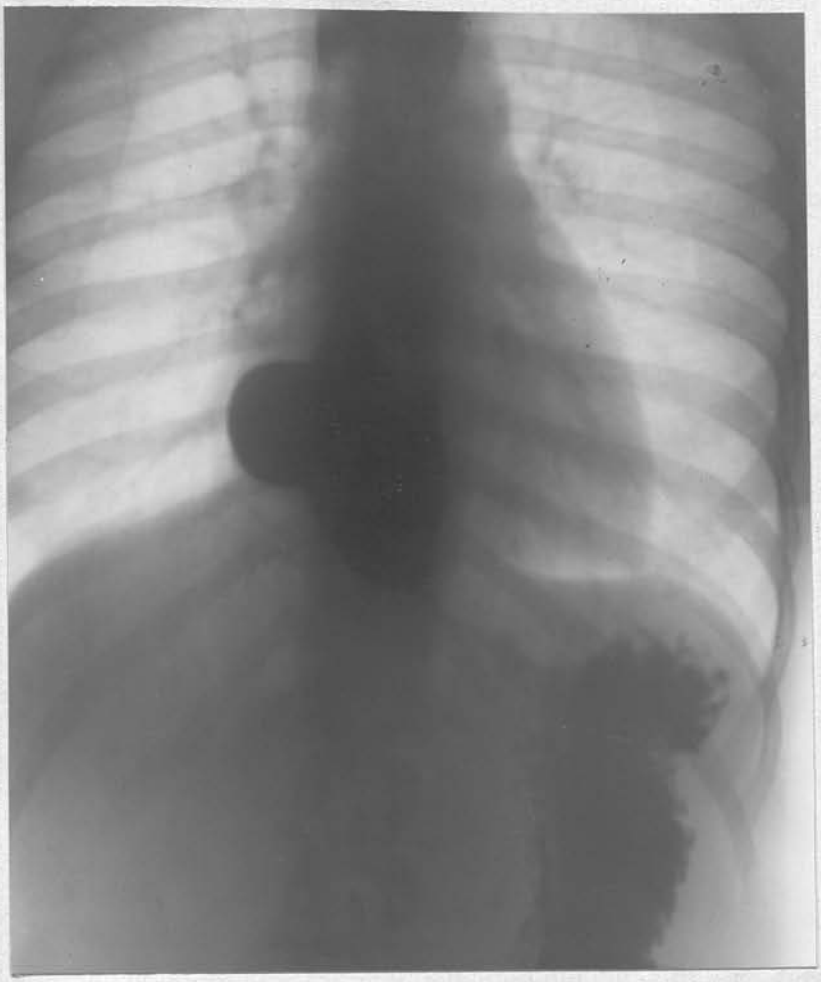


Plate (37).

Mrs. J.R. Age 42.

Cardiospasm with Pressure Diverticulum.

History: Vomiting, with achlorhydria.

X-Ray Examination: There is cardiospasm, with considerable dilatation of the oesophagus. When the patient was examined in the recumbent position, a large smooth walled diverticulum was found. It is about 1½" above the cardia, and arises from the right lateral wall of the oesophagus. Its position and appearance indicate that it is a pressure diverticulum resulting from increased intra-oesophageal pressure due to the cardiospasm.

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SPASM OF THE OESOPHAGUS.

Spasm occurring at the upper end of the oesophagus:

There is a well defined type of dysphagia, occurring chiefly in women of a hysterical or neurotic type, which appears to be due to a spasm of the crico-pharyngeus. It has also been described as being associated with anaemia and occasionally with splenomegaly.

In 1918, Dan Mackenzie reported two cases of spastic post-cricoid stricture, and the condition was very fully described in 1919 by Brown Kelly and D.R. Paterson. It has also been discussed by C. Jackson, Plummer and Vinson, and Mason Jones and Owen.

It has been suggested that the underlying cause of the spasm is a disturbance of the balance between the motor nerves (Auerbach's Plexus) and the sensory nerves (Meissner's Plexus).

It is not certain whether the condition is purely functional, or is excited initially by some local lesion, such as a pharyngitis.

According to Abel, the persistent spasm results in passive congestion at the mouth of the oesophagus, with round celled infiltration and the eventual formation of a fibrous band, called the "crico-pharyngeal band", which prevents proper relaxation of the sphincter. These changes ultimately cause atrophic chnages in/

in the mucous membrane, which may conceivably be a factor in the causation of carcinoma, which is not uncommon at this site in women.

Spasm Occurring in the course of the Oesophagus:

This may be classified as:

(1) Psychical Spasm.

(2) Reflex Spasm.

(3) Symptomatic Spasm.

(1) Psychical Spasm occurs in hysterical subjects, usually young females, and follows upon some relatively trivial emotional disturbance.

(2) Reflex Spasm of the oesophagus may result from many diseases which cause either conscious pain or subconscious irritation of the nervous system. The disease may be situated in adjacent organs, such as the pharynx or larynx, or in more remote ones, especially the uterus and the intestinal tract.

(3) Symptomatic Spasm occurs in diseases of the oesophagus itself, and with these, is described in the various sections of this thesis. While usually produced at the level of the lesion it may occur at either extremity of the oesophagus, or both at the level of the lesion and at one extremity. It also occurs in association with certain diseases of the central nervous system, such as tabes and tumours of the bulb. Thirdly,it is met with in certain intoxi-

intoxications which act upon the nervous system, such as rabies, tetanus, and rarely, influenza, typhoid fever and diphtheria. Another toxic cause of symptomatic spasm is gout.

The radiological appearances are the same in all these forms of oesophageal spasm. The barium is held up more or less completely at the level of the spasm, which appears as a smooth walled conical constriction of the barium shadow, devoid of any irregularity or filling defect. It may be necessary to mix dry bread crumbs with the barium paste in order to demonstrate the spasm, for the smooth barium is so bland and non-irritating that it may fail to excite spasm. There is usually some degree of dilatation of the hypopharynx, if the disorder is of any duration.

CARDIOSPASM.

Definition: A state of chronic spasm, or of achalasia, (failure to relax) of the cardiac sphincter, causing severe obstruction to the passage of food through the cardiac orifice, and leading to great dilatation and elongation of the oesophagus.

The condition is most often met with in young neurotic persons, especially females, but it may occur at any age.

Etiology: This is obscure. Dilatations of the oesophagus were first described by Purton in 1821, and the first detailed description was given by Rokitansky in 1840. These descriptions were based entirely on post-mortem observations. The first account of the condition in the living was by Zenker, in 1878. In 1881 Strümpell, in describing a similar case, raised for the first time the question of a spasmodic closure of the cardia as a possible cause. He dismissed the possibility, however, in favour of the view that there was kinking at the oesophageal hiatus, and secondary dilatation in consequence.

V. Mikulicz, in 1882, made the first oesophagoscopic examination in this condition. He attributed it to spasm of the cardia, and so called it cardiospasm. The condition was more precisely studied by Rosenheim in 1895, by means of the oesophagoscope, and by/

by Rumpel in 1897, using radioscopy.

Causation: All the evidence points to the existence of some obscure derangement of the neuro-muscular mechanism of the oesophagus and its sphincters as the underlying cause.

From experimental work it has been found that stimulation of the peripheral ends of the cut vagi causes contraction of the whole oesophagus, and relaxation of its sphincters - this is essentially the normal process of deglutition.

On the other hand, section of the vagi without stimulation is followed by dilatation of the oesophagus and contraction of the cardia. This corresponds to the supposed condition in cardiospasm. The vagi thus control the muscular action of the gullet and also supply dilator branches to the cardia. Tonic contraction of the cardia is maintained by the local autonomic nervous mechanism. Normally, this tonic state is inhibited during deglutition by impulses conveyed by the vagi, allowing the cardia to open in front of the descending peristaltic wave, and the bolus to enter the stomach.

In cardiospasm, there would appear to be some failure of this co-ordinated inhibition, so that the food is forced against the closed cardia, resulting in gradual dilatation and muscular hypertrophy of the oesophageal wall. The collection of food remnants above/

above the cardia causes oesophagitis, which itself tends to cause reflex spasm of the cardia. Thus a vicious circle is established.

Kraus reported degenerative changes in the vagi in certain patients suffering from so-called cardiospasm.

By feeding experiments in animals in which the vagi had been cut, Cannon produced dilatation of the oesophagus with muscular hypertrophy and spasm of the cardia, i.e., a condition comparable to cardiospasm.

Stokes and Rake demonstrated inflammatory and degenerative changes in the lower end of the oesophagus, involving especially Auerbach's plexus in the neighbourhood of the cardia.

The degree of spasm is comparatively feeble, some two or three pounds pressure being enough to overcome it. (Mosher).

Symptoms:

The onset of the disorder may be either insidious or sudden. In the latter case it has probably been latent for some time. The principal symptom is difficulty in swallowing: the normally unconscious act of deglutition becomes a conscious one. The patient has a sensation of the food being arrested behind the lower end of the sternum, and makes voluntary efforts to force it down. Often, large

draughts/

draughts of fluid are taken in order to try and force the food through the cardia. Some patients find that hot water causes the spasm to relax.

As a rule the dysphagia is first noticed with regard to solids, but later there is difficulty even with fluids. The patient may find it necessary to sit bolt upright, or even to stand, when trying to swallow. There may also be tendency to gulp down large quantities of air, and to take long, deep breaths during the act.

There is a feeling of weight and discomfort behind the lower end of the sternum or in the epigastric region after meals, but there is not usually actual pain: Pain, with dysphagia, is more suggestive of spasm associated with some organic lesion, such as peptic ulcer.

As the condition develops, regurgitation begins to occur, and gradually increases both in frequency and amount. At first, this may be accompanied by a certain degree of nausea, but ultimately, the food is simply poured out, without any effort or discomfort. The patients usually describe the regurgitation as "vomiting", but the food is returned quite unaltered, except in long-standing cases in which there is a great degree of dilatation, when the regurgitated matter may be offensive as a result of stasis with consequent decomposition.

As/

As in the case of pharyngeal diverticulum, in which there is also an underlying element of neurosis, the symptoms are liable to be aggravated if the patient has to take the meal in the presence of strangers. There may be periods of remission, and on the other hand, the symptoms may have a sudden onset, perhaps in the middle of a meal. This is especially apt to happen after some violent emotional disturbance.

Some subjects actually feel the food suddenly pass through the cardia, after a longer or shorter period of arrest above it.

The Radiological Findings are very characteristic. The barium mixture, whether of the consistency of fluid or of paste, is almost or entirely held up at the cardia. The oesophagus is found to be dilated, but to a very variable degree. The shadow may be parallel sided, in minor degrees of dilation, or pear-shaped. It may seem to fill entirely the posterior mediastinal space, and the amount of dilatation is usually very much greater than that seen above a malignant, or even a cicatricial stricture. If it is extreme, the gullet is elongated, and in the anterior view shows a deviation to the right, so that the oesophageal shadow projects beyond the right border of the cardio-vascular shadow. In the oblique position/

position, backward deviation is also found.

The lower end of the barium filled oesophagus forms a spindle shaped shadow, with a fine, tapering thread-like process extending through the cardia from its most distal point. In most cases, the barium is seen to trickle slowly through the spastic cardia in a very thin stream, but in others the obstruction may be absolute for some considerable time. In long standing cases the lower two or three inches of the dilated and elongated tube may, owing to this backward displacement, come to lie at a considerably lower level than the cardiac orifice, which is held in position by the crura of the diaphragm. This tends to increase the degree of obstruction.

Where there is definite hypertrophy of the oesophageal walls, this may be recognised even on the screen, as a faint shadow some quarter of an inch or more in width, outside the barium shadow and exactly following its outlines. In old standing cases there may be a quantity of retained food remnants forming a pultaceous mass in the oesophagus. This, becoming coated with, and partially permeated by the barium produces a very curious mottled shadow, which may show a sharply defined upper pole. Solid food remnants may also break up the normally smooth outline of the lower pole of the barium shadow, and cause an irregular appearance at first suggestive of the filling/

filling-defect of carcinoma.

In certain cases, it may be found that no food will pass through the cardiac orifice until the oesophagus has been completely filled up to the level of the manubrium (i.e. until a pressure of some eight inches of fluid has been attained) when the spasm suddenly relaxes, and almost the whole column of fluid passes abruptly into the stomach. As a rule, however, before the entire mass has passed through, the spasm is re-established and does not again give way until the oesophagus has once more been filled up to the critical level. More frequently, however, the barium very slowly trickles through the cardia in a thin stream.

The differential diagnosis is from cicatricial stenosis and carcinoma. In the first place the history is an important guide. The degree of dilatation of the oesophagus in a well marked case of cardiospasm is very much greater than is ever seen in carcinoma, and greater than what is in any way usual in simple stricture.

In both these conditions the site of obstruction is in most instances above the level of the cardia.

In simple stricture the barium shadow is cup shaped, with a narrow tail-like prolongation below, representing the actual fibrosed portion of the lumen. In cardiospasm, the cut-off is far more sudden, the/

the shadow having only a very fine and short inferior prolongation.

The essential feature in carcinoma is the irregularity in outline of the shadow. It has already been pointed out that in certain cases of cardiospasm there may be a residue of solid food remnants at the lower end of the dilated oesophagus at the time of examination, which may displace the barium, and so cause irregularity of the outline of the shadow which may be mistaken for that of carcinoma. In any case of doubt, the oesophagus should be washed out and the X-Ray examination repeated.

Certain cases of carcinoma of the epicardial portion of the oesophagus may cause considerable dilatation of the gullet, and may at first sight suggest cardiospasm. Careful examination will reveal some irregularity of the lumen which will show the true nature of the condition. In this connection attention may be drawn to the case of A.R. (Plate 17, page 73). But for the irregular appearance of the lumen immediately below the dilated portion, this might be taken for a cardiospasm. The plate should be compared with the two cases of cardiospasm with relatively minor degrees of dilatation, H.H.(Plate 39) and A.C. (Plate 40).

The case of A.C. is of interest in that the patient was a well developed youth of eighteen, without any other signs of neurosis. Yet he had had a well/

well marked cardiospasm for eighteen months, at the time of the examination. For the past six months he had been treated by the passage of the mercury bougie. While the patient stated that he had derived benefit from this procedure, the degree of obstruction as estimated radiologically was unchanged.

The cases of Miss B. and Mrs. E. McG., shown at the end of this section, are good examples of the radiological findings in cases of long standing. The elongation and tortuousness of the oesophagus is well seen. The slight irregularity of the outline of the barium shadow in some of the radiograms of Mrs. McG. is due to the retention of fragments of previous meals in the dilated oesophagus.

Plate (39).

H.H. Female. Age 20.

Cardiospasm.

Complaint: Dysphagia, and regurgitation of food.

The patient, who is neurotic, states that "food sticks in her throat", and is sometimes "vomited". She also finds that a drink of hot water may cause the food to pass down.

X-Ray Report: Typical cardiospasm, with very considerable dilatation of the oesophagus.

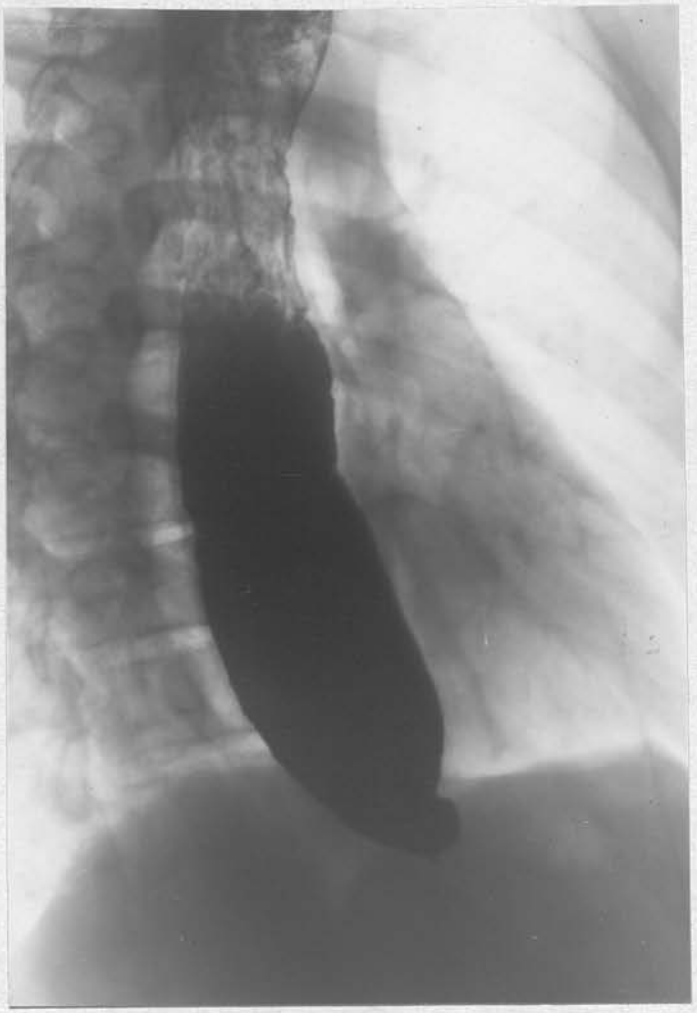

Plate (40).

A.C. Male. Age 18.

Cardiospasm.

Complaint: Difficulty in swallowing, at first only with solid food, but latterly even with liquids. The food is sometimes regurgitated, and the trouble is worst in the presence of strangers. The symptoms have been present for 18 months. For the last six months, the patient has been treated by the repeated passage of the mercury-filled tube. He states that this has produced a certain amount of symptomatic improve-

ment, but there has been no modification of the radiological appearances as a result of this treatment. The patient is not in any way a neurotic subject, and is well developed and well nourished.

Radiological Examination: There is a very marked degree of cardiospasm, with considerable oesophageal dilatation. No food whatever passes through the cardiac orifice until the oesophagus has been filled up to the level of the lower border of the manubrium sterni, when the cardia suddenly relaxes, and almost the whole of the oesophageal contents are allowed to pass through into the stomach. The cardia immediately re-closes, and does not let any more food pass through until the oesophagus has once more been filled up to the critical level

The lower pole of the barium shadow shows the spindle shape, with a very fine process entering the cardiac orifice, which is typical of this condition.

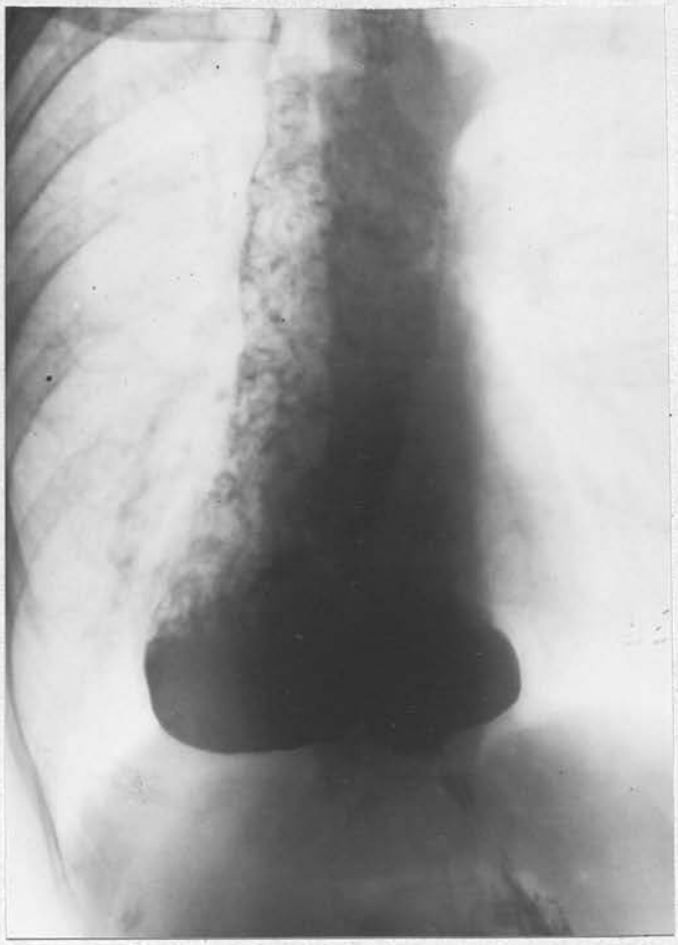

Plate (41).

Miss. B. Age 35.

Cardiospasm.

Complaint: The patient, who is a highly neurotic woman, gives a history of intermittent dysphagia extending over a period of 20 years. She states that the food seems to stick for a time, and then to "go down with a thud".

Radiograph in the anterior position, to show the deviation to the right of the dilated and elongated oesophagus.

Plate (42).

Miss. B. Age 35.

Cardiospasm.

Radiograph in Right Anterior Oblique Position.

X-Ray Report: The examination shows an extreme degree of cardiospasm. The oesophagus is very greatly dilated, and is elongated, showing the typical deviation towards the right side. The characteristic fusiform constriction at the cardiac orifice is also well seen. Obstruction is very marked.

Plate (43).

Miss B. Age 35.

Cardiospasm.

Anterior Radiograph of Cardia and Stomach.

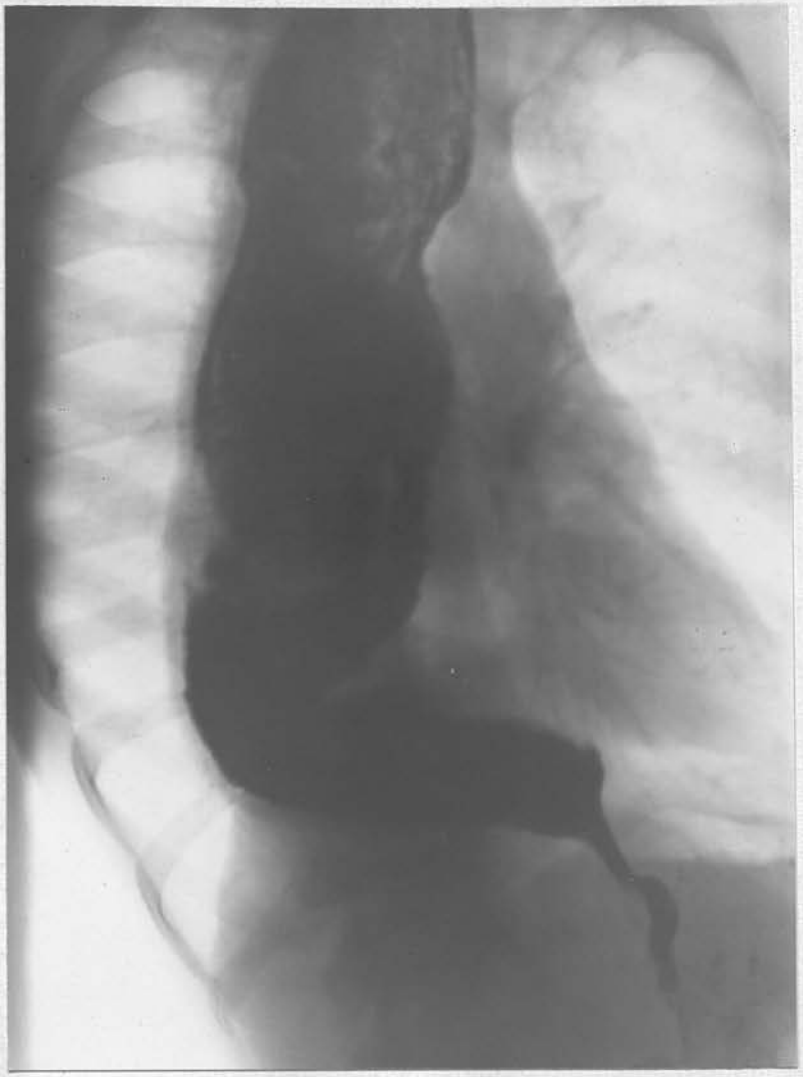

Plate (44).

Mrs. E. Mc.G. Age 45.

Cardiospasm. Oblique View.

History: Gastric ulcer six years ago: Haematemesis. Treated medically. Since the age of 14, she has had some slight difficulty in swallowing, especially after breakfast. For the last two months, there has been retro-sternal pain immediately after food. The food may suddenly be regurgitated, without any feeling of nausea, and tastes as it did when swallowed. On other occasions she feels that the food, after having stuck for a time

at the lower end of the oesophagus, suddenly passes on into the stomach.

X-Ray Examination: There is an extreme degree of cardiospasm, the oesophagus being greatly dilated and elongated. The oblique position(radiograph on the previous page) shows that there is marked backward deviation, while the anterior view (below) shows deviation to the right. There is also some hypertrophy of the walls, this thickening being well seen in the films. Barium was trickling slowly and in a thin steam through the cardia into an apparently normal stomach. The outline of the lower end of the gullet is somewhat irregular as a result of displacement of the barium by retained food remnants. After 6 hours, there is a faintly barium coated mass filling the lumen of the oesophagus to the level of the manubrium. It has a well defined upper surface, and when more barium is swallowed, it is seen to strike this mass and to spread out and trickle down its anterior and right surfaces. This appearance would seem to be caused by a mass of old, inspissated food remnants.

Plate (45).

Mrs. E. Mc.G. Age 45.

Cardiospasm.

Anterior radiograph, showing deviation of the oesophagus to the right, with some irregularity of the barium shadow due to retained food material.

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PARALYSIS OF THE OESOPHAGUS.

Paralysis or paresis of the oesophagus occurs not uncommonly in the course of certain diseases involving the nuclei or trunks of the vagi.

In these cases of central origin, the dysphagia may be overshadowed by other associated disturbances in the innervation of the pharynx, larynx, etc. Even when dysphagia alone is present, it is not always possible to determine in how far this is due to paralysis of the oesophagus, apart from the paralysis of the muscles of deglutition.

Toxic neuritis, such as follows diphtheria, gives rise to most of the cases of paresis of the oesophagus met with.

Botulism is a striking instance of such a toxic neuritis.

In the famous epidemic of botulism at Loch Maree in 1922, paralysis of the oesophagus was a marked feature in several of the victims. These cases have been fully described by Brown Kelly

The distribution of the nerve supply to the gullet is such that it is possible to have paralysis of its upper third, without involvement of the part below.

The radiological examination in a case of paralysis of the oesophagus shows dilatation of the whole of the paralysed portion. It is not possible for the patient to swallow when lying down. If Barium is

given whilst the patient is in this position, it simply lies in the oesophagus, without being carried onwards to the cardia by peristaltic waves.

FOREIGN BODIES.

A great variety of foreign objects may find their way into the oesophagus.

Chevalier Jackson classified those that have come under his observation in his enormous experience under the following headings:- Hardware, jewelry, pins and needles, safety pins, glass, dental and surgical objects, toys, coins, seeds and nuts, shells, meat, buttons.

The symptoms vary according to the location, size and surface of the body. A large body in the pharynx or behind the larynx may press on the latter to such an extent as to cause choking, the patient making frantic efforts to swallow or to expel it, and becoming intensely cyanosed. This phase is unlikely to be met with in cases referred for X-Ray examination.

Sharp bodies which lacerate the mucosa cause marked pain which is exaggerated at each attempt at deglutition. Large smooth objects which merely block the tube cause pain which is characteristically duller.

The obstruction is not usually complete, and the patient can generally swallow fluids, even though this may be painful.

The mucosa may be so injured by a sharp foreign body as to give rise to scarring, with the development/

development of a stricture later on.

The radiological localisation of radio-opaque foreign bodies of appreciable size obviously presents no difficulty. Those of considerable size are almost invariably arrested at the upper extremity of the gullet, opposite the cricoid cartilage, this being the first anatomical narrowing. They are thus found to be impacted at exactly the same point at which pharyngeal diverticulum occurs. Objects which pass this point are unlikely to become impacted in the oesophagus at all, unless they carry sharp projections (as in the case of some dentures) which may catch in the mucosa. In that case they may be found to have become impacted at any level. Small foreign bodies, such as pins and needles, and particularly fragments of metal turnings from the saucepan scrubbers now so common, may be very difficult or even impossible to distinguish upon the screen, but will be shown by a good radiograph, taken in one of the oblique positions with a really short exposure. The radiograph should never be omitted when there is any possibility of the presence of a small radio-opaque body, and the screen examination fails to reveal it. The examination should include the pharynx, since small sharp fragments may penetrate its posterior wall, before the oesophagus is reached.

When the body alleged to have been swallowed is transradiant/

transradiant, the difficulty of radiological localisation is very great. In fact, it is usually impossible.

Of non-metallic foreign bodies, the commonest are small fragments or spicules of bone, wood, etc. If they penetrate the wall of the gullet and become impacted, they may, from the irritation which they cause, produce a localised spastic constriction of the lumen at or near the same level, which may be found when barium is given. Such a local spasm, with a history of a swallowed body, is very suggestive.

In the normal oesophagus, there is never obvious peristalsis comparable to that seen in the stomach. Should the barium shadow show definite hyperperistalsis, comparable to that seen in the irritable stomach, though of course on a far smaller scale, it is evidence of acute obstruction. The appearance is usually associated with the impaction of a foreign body, and may therefore be evidence of the presence of one which is transradiant. An example of this is the case of E.J. (Plate 52). In this case there was a history of the sudden onset of oesophageal obstruction, with total inability to swallow even water, the patient believing that she had swallowed some foreign body. The X-Ray examination showed complete obstruction, with violent hyperperistalsis, which is well seen in the print. No foreign shadow could be seen. The obstructing body was apparently dislodged by the barium, for some time after the examination, the

symptoms passed off, and at a subsequent direct examination nothing abnormal was found.

It has been suggested that small portions of cotton wool, teased out and impregnated with barium emulsion, should be given to the patient to swallow, in the hope that they may become entangled by a trans-radiant foreign body and so make it visible. It may be said that this proceeding is very unlikely to be successful.

It must be admitted that the majority of trans-radiant foreign bodies cannot be localised by radio-logical means, and require oesophagoscopy.

The examples of swallowed foreign bodies shown hereafter are self-explanatory, but special mention may be made of Plate 51, Mrs R.W. This is an ex-ample of the very small metallic foreign body which is practically certain to be missed if the X-Ray examination is confined to screening, without radio-graphy, for so small a fragment is almost impossible to make out upon the screen. In this case it is very well defined in the lateral film of the cervical re-gion, but it was quite invisible in the anterior film, being superimposed upon the much denser shadow of the body of the second cervical vertebra.

Plate (46).

J.B. Male. Age 22.

Impacted Foreign Body.

The patient swallowed a dental plate carrying one tooth. The oblique radiograph shows that the plate is lying at the upper oesophageal orifice, at the level of the sixth cervical vertebra. This is the first anatomical constriction of the gullet, and is the point at which all large foreign bodies, such as coins and dentures, are arrested, and usually become impacted.

Plate (47).

J.B. Male. Age 22.

Impacted Foreign Body.

Anterior radiograph, showing a small dental plate impacted at the upper extremity of the oesophagus, opposite the sixth cervical vertebra.

Plate (48).

Impacted Foreign Body.

The radiograph, in the right anterior oblique position, shows a coin impacted in the characteristic position, at the junction of the oesophagus with the pharynx. Barium was given in order to define the position of the oesophagus, and is seen extending downwards from the lower border of the coin.

Plate (49).

Impacted Foreign Body.

Anterior radiograph of the same patient, before the administration of barium.

Plate (50).

J. R. Male. Age 7.

Foreign Body.

The radiogram shows a metal pencil cover lying in the oesophagus immediately above the bifurcation of the trachea.

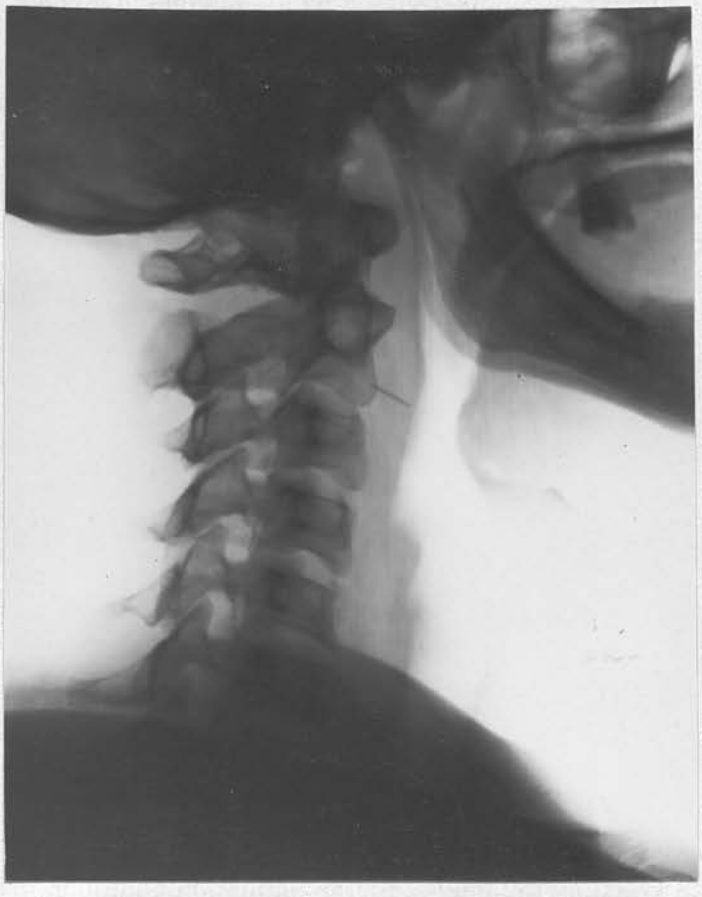


Plate (5I).

Mrs. R.W. Age 32.

Wire Bristle embedded in Posterior Pharyngeal Wall.

History: While eating some porridge, pt. suddenly felt that she had swallowed some small metallic object. This was felt to catch in her throat, but she was not quite sure of it, though she thought it might be a piece of wire from a pan scrubber. She forgot the incident for a few days, when she began to have pain on swallowing. Direct examination showed some swelling and tenderness of the posterior pharyngeal wall.

The lateral radiogram of the cervical region shows a piece of wire in the prevertebral muscles, opposite to the body of the second cervical vertebra.

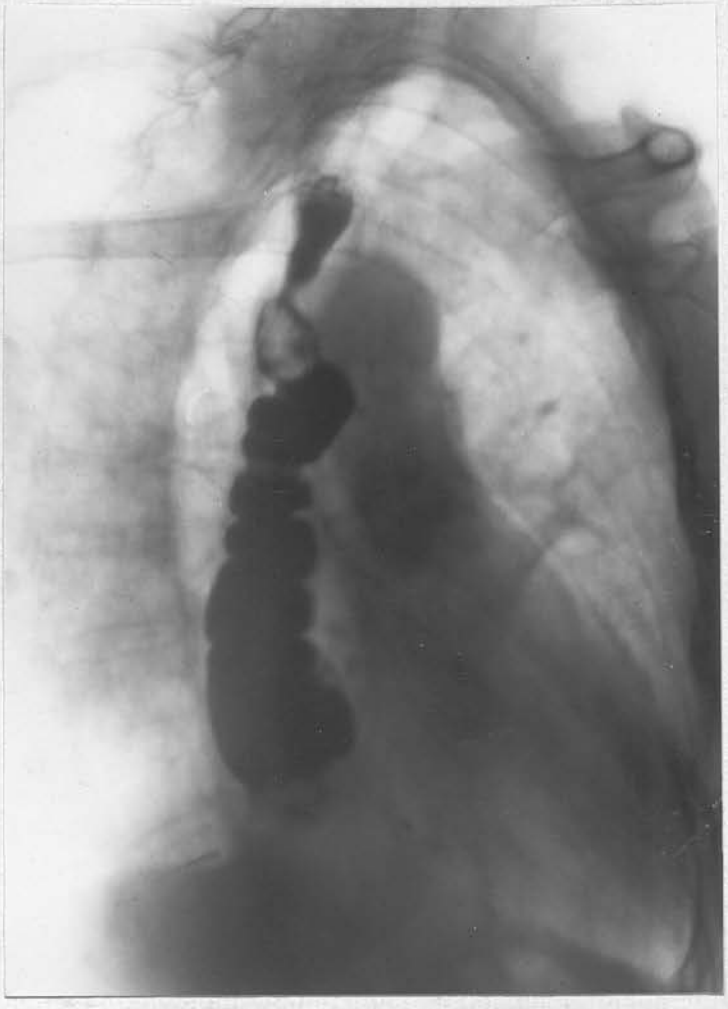


Plate (52).

E.J. Female. Age 79.

Acute Obstruction.

History: The patient states that she was eating a sausage the day before the examination, and that there was something hard in it which she swallowed, and which she now feels sticking. Now is unable to swallow anything, even a mouthful of water being regurgitated immediately. Has had no difficulty in swallowing before, except for a history of having swallowed something 7 years ago, which was removed in another hospital.

X-Ray Examination by screen and film did not show

any radio-opaque foreign body. On giving thick barium, a definite complete obstruction was seen 3 inches above the cardia, with hyperperistalsis above, indicating acute obstruction.

Direct Examination. (Dr. W.T.Gardiner.)

"The oesophageal speculum was passed as far as the aortic arch, but no obstruction was found. Patient states that when she swallowed the barium for the X-Ray, she felt as if the F.B. had gone."

OESOPHAGEAL OBSTRUCTION DUE TO EXTRINSIC PRESSURE.

In the neck, the commonest causes are new growths of the pharynx, larynx and trachea, and various forms of goitre.

In the thorax, an aneurysm of the aortic arch or of the descending aorta is the commonest cause of extrinsic obstruction.

Enlarged glands in the posterior and superior mediastina are also a common cause.

This glandular enlargement may be due to a variety of causes.

The chief group comprises those glands which are the seat of chronic inflammation, especially infection by the tubercle bacillus.

Syphilis of the lymphatic glands also occurs in this situation, especially in the tertiary stage, and produces gummatous changes in the glands which by their close proximity to the oesophagus cause pressure upon its lumen.

Malignant infection of the glands secondary to a cancer of the breast is another cause. Other possible causes may be briefly summarised

Glandular enlargement secondary to any malignant focus below the thorax.

Lymphadenomatous glands.

Retro-sternal goitre.

Cold/

Cold abscess from Pott's disease of the thoracic spine.

Any new growth of lungs, pleurae or mediastina.

In the abdomen:

New growth of the stomach in the region of the cardia.

Enlargement of the liver, inflammatory, malignant or scirrhotic.

In all these conditions of obstruction from extrinsic pressure, the most important diagnostic aid is the radiological examination, which in a large proportion of the cases will give conclusive evidence of the nature of the lesion. It is in this group of cases that this form of examination takes precedence even over direct examination.

Two examples of obstruction from extrinsic pressure resulting from aortic aneurysm are given in the succeeding pages.

Plate (53).

Wm. B. Male. Age 62.

Obstruction due to Extrinsic Pressure.

Complaint: Difficulty in swallowing solid food.

X-Ray Examination: The screen examination showed a large aneurysm of the descending aorta, which is encroaching upon the posterior mediastinum, and causing marked displacement and compression of the oesophagus.

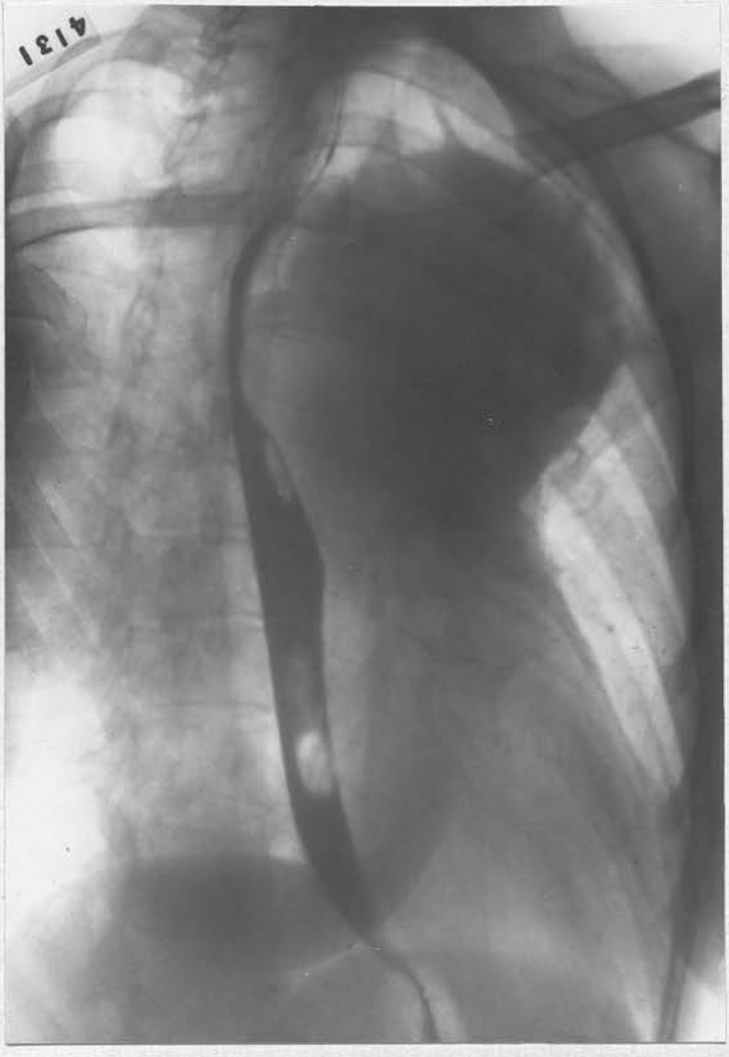


Plate (54).

Mrs. M.W. Age 53.

Obstruction due to Extrinsic Pressure.

History: Difficulty in swallowing: ? post-cricoid stenosis.

X-Ray Examination: Screen examination showed a large pulsating foreign shadow in the upper half of the left chest, and continuous with the aortic shadow. On giving barium, the oesophagus was seen to be compressed. Conclusion: Aneurysm of descending aorta, causing pressure upon the oesophagus, with partial obstruction of it.

PARA-OESOPHAGEAL HERNIA.

Definition:

A true, non-traumatic herniation of a part of the cardiac portion of the stomach through the oesophageal opening of the diaphragm.

Etiology:

The condition occurs at all age periods, but recorded cases show a marked preponderance in the case of women who have passed middle life. There may be a history of increased intra-abdominal pressure, due to some cause such as the cough of chronic bronchitis, or frequent staining at stool.

The oesophageal orifice is situated in the muscular portion of the diaphragm, behind the central tendon, and is consequently distensible.

Para-oesophageal hernia has been considered to be a very rare condition, but records of the radiological investigation of the oesophagus would suggest that this is not the case.

Richards (1) considers that the most important predisposing factor is an interference with the normal closure of the pleuro-peritoneal membranes in foetal life.

Symptoms:

These are characteristically very vague. They may simulate those of gall-bladder disease, or of gastric/

gastric or duodenal ulcer, even showing at times periodic remissions suggestive of the latter. A common complaint is of pain just below the ensiform, and of abdominal distress on assuming the recumbent posture soon after a meal. There may be acid eructations, due most probably to the relaxation of the cardiac sphincter which is a part of the condition. This may be relieved by alkalis.

The only symptom may be dysphagia, which may closely simulate that of malignant stricture of the oesophagus.

Again, the symptoms and history may lead to a clinical diagnosis of gastric malignancy, as in one of the cases illustrated later.

Diagnosis:

As a result of the atypical character of the symptoms and signs, the condition is seldom diagnosed clinically, but is most often found as a result of radiological examination.

When the passage of the barium is observed with the screen, there is at first nothing abnormal to be seen. There may be, as suggestive signs, a slight increase in the normal delay at the cardiac orifice, and the epicardial oesophagus may turn unusually sharply to the left. If, when the stomach has been filled with the fluid opaque meal, the patient assumes/

assumes the supine position with the foot of the couch raised, a portion of the barium filled cardia may be seen above the diaphragm, in the posterior mediastinum. It varies in size from that of a hazel nut to that of a small orange. Manual pressure on the upper abdomen, or coughing or straining on the part of the patient may be required in order to reveal the lesion. The shadow above the diaphragm is seen to be definitely a part of the stomach, and typically communicates with it by a wide channel. It may contain a subsidiary gas bubble.

Differential Diagnosis:

Para-oesophageal hernia is to be distinguished from:

(1) Cardio-oesophageal relaxation described by Robins and Jankelson (2).

This is a relaxation of the cardiac orifice with a generalised dilatation of the lower oesophagus, but without the formation of a definite pouch. Clinically, this condition is not usually associated with pain.

(2) Diverticulum at the lower end of the oesophagus.

This is a budding off from the oesophageal wall, and fills as the barium first passes down, whereas in hernia the pouch is not revealed until the stomach has been filled.

(3)/

(3) Diverticulum of the stomach wall.

In this case there is a pouch directly connected with the fundus, but it is situated below the diaphragm.

(4) Cardiospasm.

There is great dilatation, of a tubular type, of the whole oesophagus. This terminates just above the diaphragm in a typical V-shaped lower pole. At first at any rate, none of the barium enters the stomach, whereas in hernia, the stomach must be filled before the lesion can be seen.

(5) Carcinoma.

The typical appearance is that of an irregular filling defect, and not of a pouch.

(6) Perforation of the oesophageal wall, with the formation of a pseudo-pouch has been observed to simulate hiatus hernia, but as non-traumatic perforation is almost always due to carcinoma, the characteristic signs of that condition will be present.

(7) Congenital short oesophagus, with consequent thoracic stomach.

This can be differentiated from hiatus hernia by careful screen examination in various positions.

This condition is of great radiological interest.

It may be entirely symptomless, and may only be discovered/

discovered at post mortem examination. This was so in the case published by Bailly, and quoted below. Various degrees of the anomaly may be found. The whole stomach may lie above the diaphragm or, more usually, part of the pyloric end may be in the abdomen, the oesophageal hiatus being occupied by stomach, instead of by oesophagus.

That portion of the stomach which lies in the thorax is found in the posterior mediastinum, in the place of the part of oesophagus which is absent.

Keith has published an account of a number of cases of varying degree.

The following is an abstract of the first published case of the condition:

"A Case of Thoracic Stomach."

Percival Bailly,

Anatomical Laboratory of the North-Western University Medical School.

Copied from:

The Anatomical Record. Vol. XVII. No. 2. Oct. 1919. Pp. 107-109.

"The condition was found in the course of the "regular dissection. The body was that of a certain "Ephraim Trimble, who died in the Lake Forrest Sana- "torium of Cork County at the age of 77."

"In his clinical history there was no mention "of any gastric disturbance and the nurse in charge "of his ward stated that his appetite was good to "within a short time of his death, and that he never "complained of any trouble referableto his stomach. "Neither/

"Neither were there any discoverable cardiac distur-
"bances."

"Clinically, there was no reason to suspect any
"abnormality. He died of arterio-sclerosis and
"interstitial nephritis."

"On opening the abdomen it was found that only
"the pyloric antrum was present in the abdominal
"cavity, projecting downwards a distance of 6 cm.
"(Fig.1)."

"At the opening in the diaphragm, the diameter
of the stomach was about 2 cms. The duodenum was
"of course practically completely visible, only the
"lowest part being covered by the transverse meso-
"colon. For a distance of 10 cms. beyond the py-
"loric sphincter, it was bound to the liver by the
"lesser omentum. The rest of the duodenum not
"covered by transverse mesocolon was attached only by
"the dorsal mesoduodenum, resembling in shape very
"much the sigmoid mesocolon; an unusual case of per-
sistence of the dorsal mesoduodenum."

"The opening in the diaphragm lay at the level
"of the eleventh thoracic vertebra. It was 4 cms.
"in width. The anterior border was formed by a
"tough fibroid band which was attached at either end
"to the body of the eleventh thoracic vertebra, and
"hugged the vertebra closely, so that the opening was
"a semicircular slit. Through it the abdominal
"cavity communicated freely with a cavity in the
"thorax."

"On opening the thorax the body of the stomach
"was found to lie between the pleural cavities and
"behind the pericardium, in the posterior mediastinum.
"It was completely surrounded by a serous sac which
"was continuous with the peritoneum through the open-
"ing in the diaphragm. (Fig.2) ".

"There was a rudimentary gastric omentum. The
"left gastric artery arose from the coeliac, and the
"left gastro-epiploic from the splenic at the usual
"level, and passed upwards through the diaphragm to
"the stomach. The oesophagus was short, and ended at
"the level of the third costal cartilage.

"It will be seen from this brief description that
"there is no evidence that the stomach had herniated
"into the thorax. Its position and relations may be
"explained by supposing that the anlage of the stomach
"lay abnormally far anterior on the alimentary canal.
"The peritoneal pockets around the stomach develop be-
"fore the descent of the diaphragm, and finding the
"peritoneal relations already developed, the diaphargm
"would necessarily leave above it, as it descended,
"not/

"not only the stomach, but also the extension of the
"peritoneal cavity.".

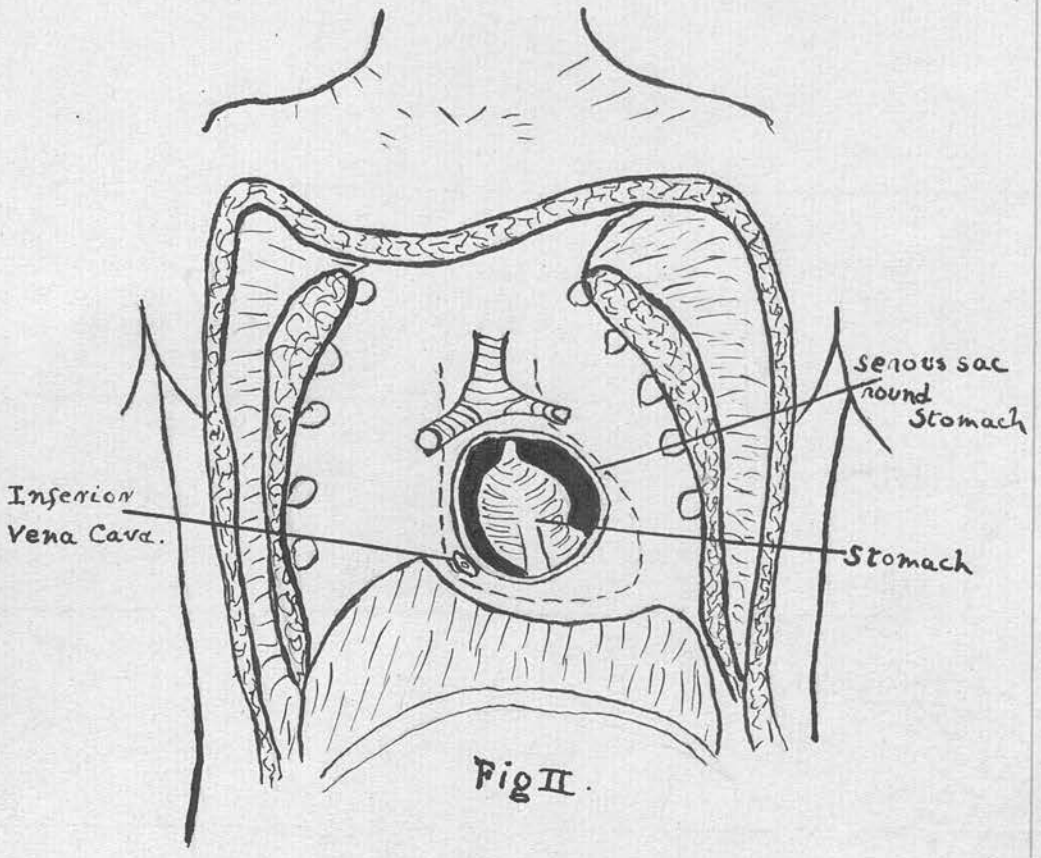

serous sac
round
Stomach
Inferior
Vena Cava.
Stomach

Fig II.

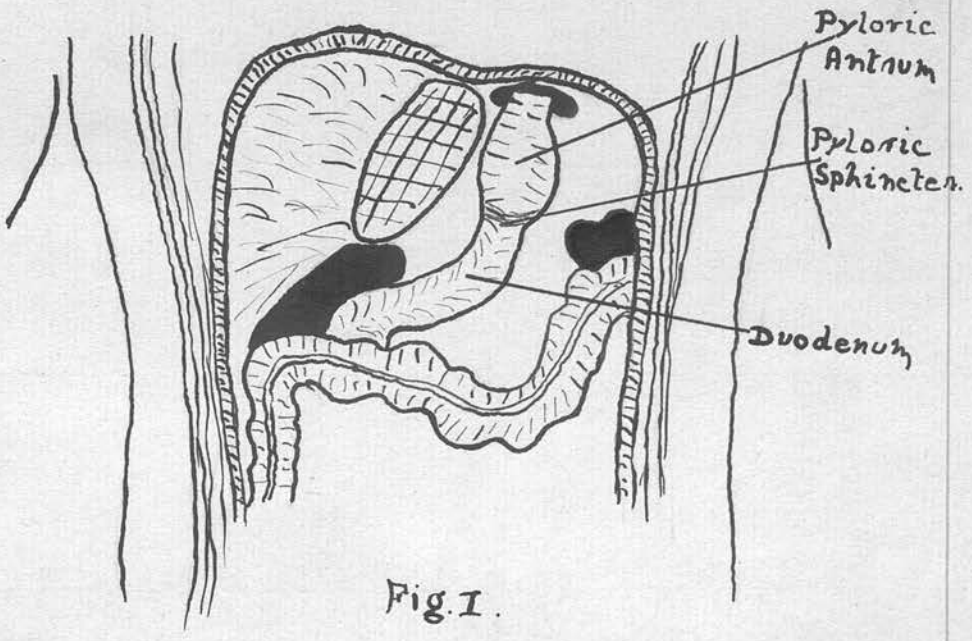

Pyloric
Antrum
Pyloric
Sphincter.
Duodenum

Fig. I.

ILLUSTRATIVE CASES.

Wm. J. (Male) (Plates 55 and 56.)

This is a well marked case of hiatus hernia. In the anterior radiograph a large sac, communicating with the cardia through the oesophageal orifice, is seen to be above the diaphragm and to the left of the lower end of the oesophagus. It contains a large gas bubble.

Mrs. N. (Female) (Plate 57.)

In this case, the radiological appearances are very like those of the last patient, but the distinction between the herniated portion of the cardiac end of the stomach and the lower end of the oesophagus is very well seen. The hernial sac passes through the oesophageal orifice to the left of the oesophagus, and contains a very large gas bubble.

Mrs. W. (Plate 58.)

There is a large sac lying above the diaphragm and communicating with the rest of the fundus of the stomach by a typically wide channel.

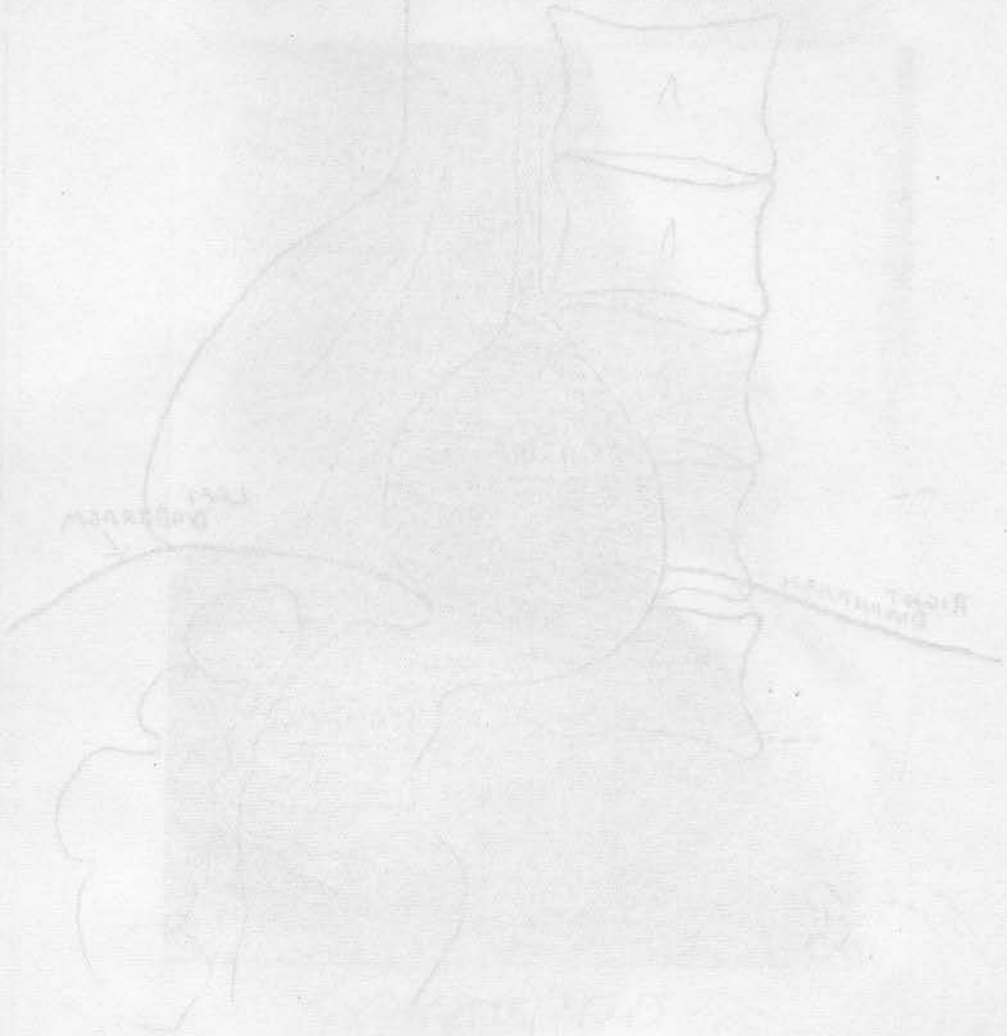
In contrast with these cases of para-oesophageal hernia, two examples of cardio-oesophageal relaxation are shown: Cases J.S. and Mrs. A. (Plates 59 & 60.)

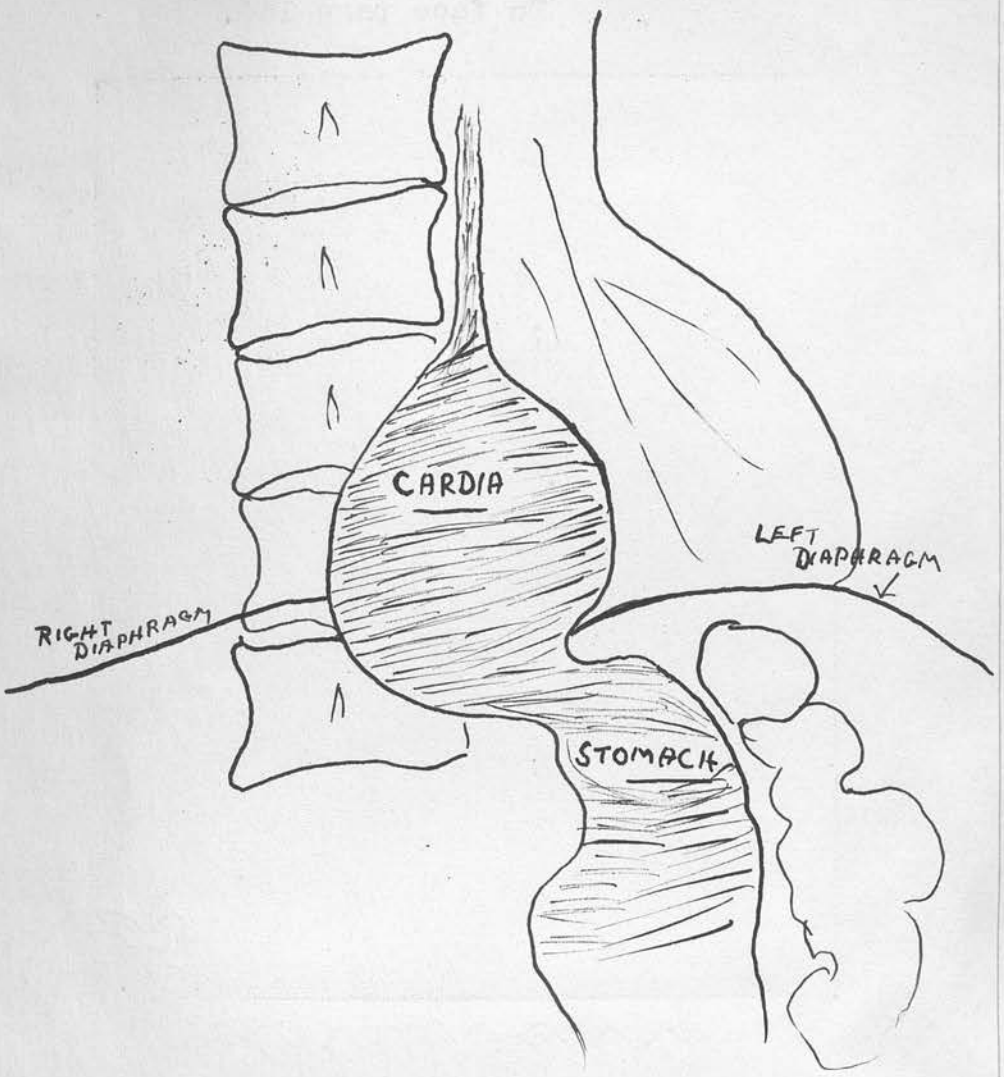
In these, the pouch, which in both cases is much smaller than in the hernias, is seen to be simply a dilatation of the epicardial oesophagus, associated with a patulous cardiac orifice, instead of being a definite hernial sac pushing its way through the hiatus at the side of the epicardial oesophagus.

Finally, an example of congenital short oesophagus, with partial thoracic stomach, is given: Mrs. B. (Plate 6I.) Here, the sac is seen to be continuous/

continuous with the oesophagus, and to show the typical rugae of the cardiac portion of the stomach. In contra-distinction to hernia, the cardia is seen to take the place of the lower oesophagus, not to simply pass up to one side of it.

To face page I64.





Wm. J.

PARA-OESOPHAGEAL HERNIA.

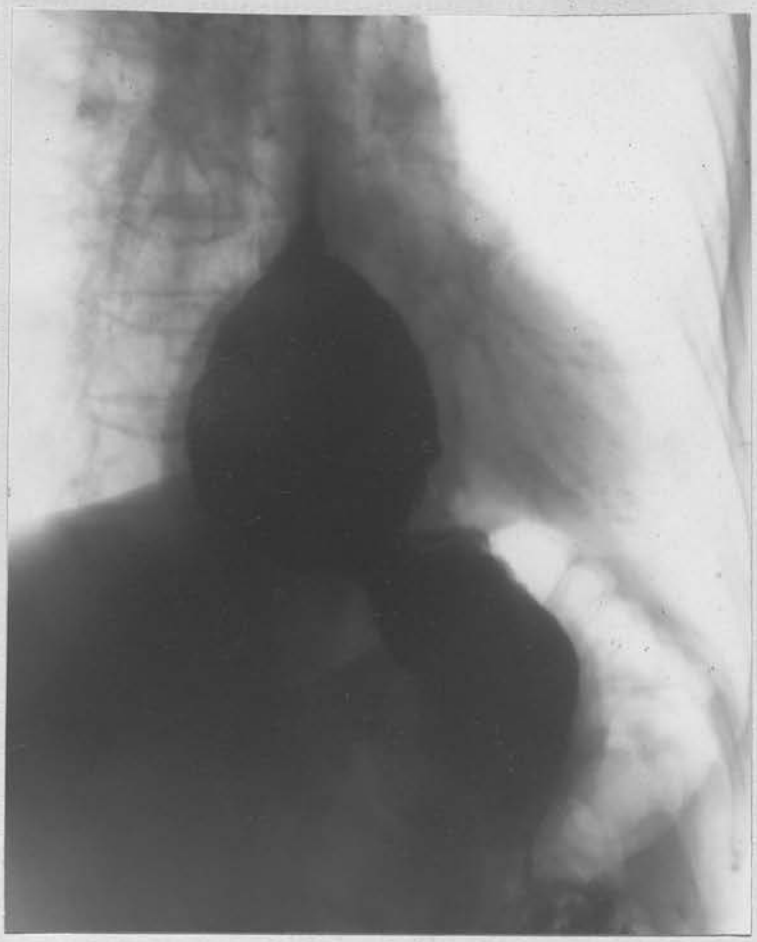


Plate (55).

W.J. Male. Age 78.

Para-Oesophageal Hernia.

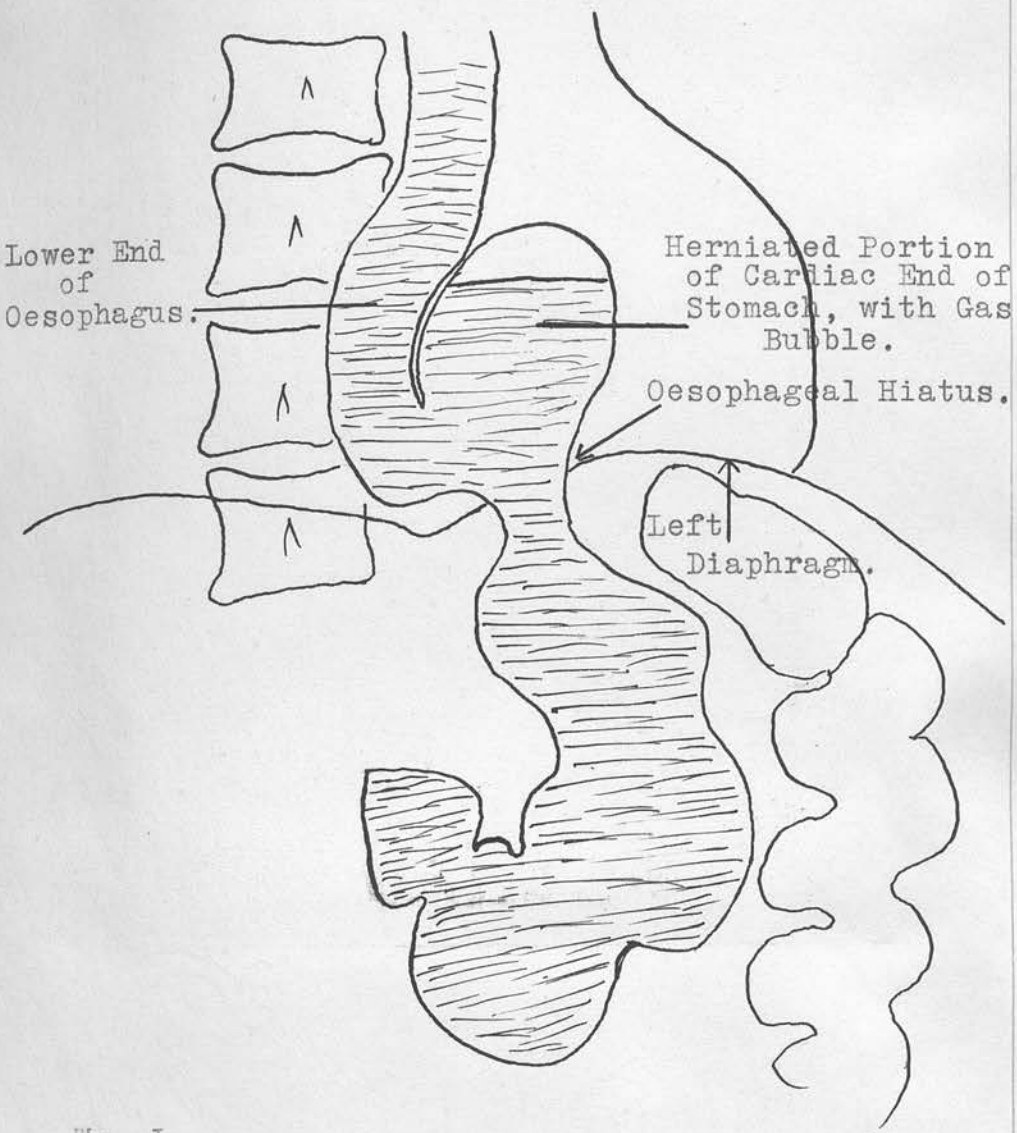
History: Dyspepsia, Anorexia, Loss of weight.

Clinical Diagnosis: ? Gastric Neoplasm or Ulcer.

X-Ray Report: The screen examination showed a para-oesophageal hernia of the cardiac end of the stomach. The herniated portion forms a sac the size of a tangerine orange, lying to the left of the lower end of the oesophagus, and containing a large gas bubble.

The remainder of the stomach and the duodenum were radiologically normal.

The radiograph is an anterior one.



Wm. J.

PARA-OESOPHAGEAL HERNIA.

Plate (56).

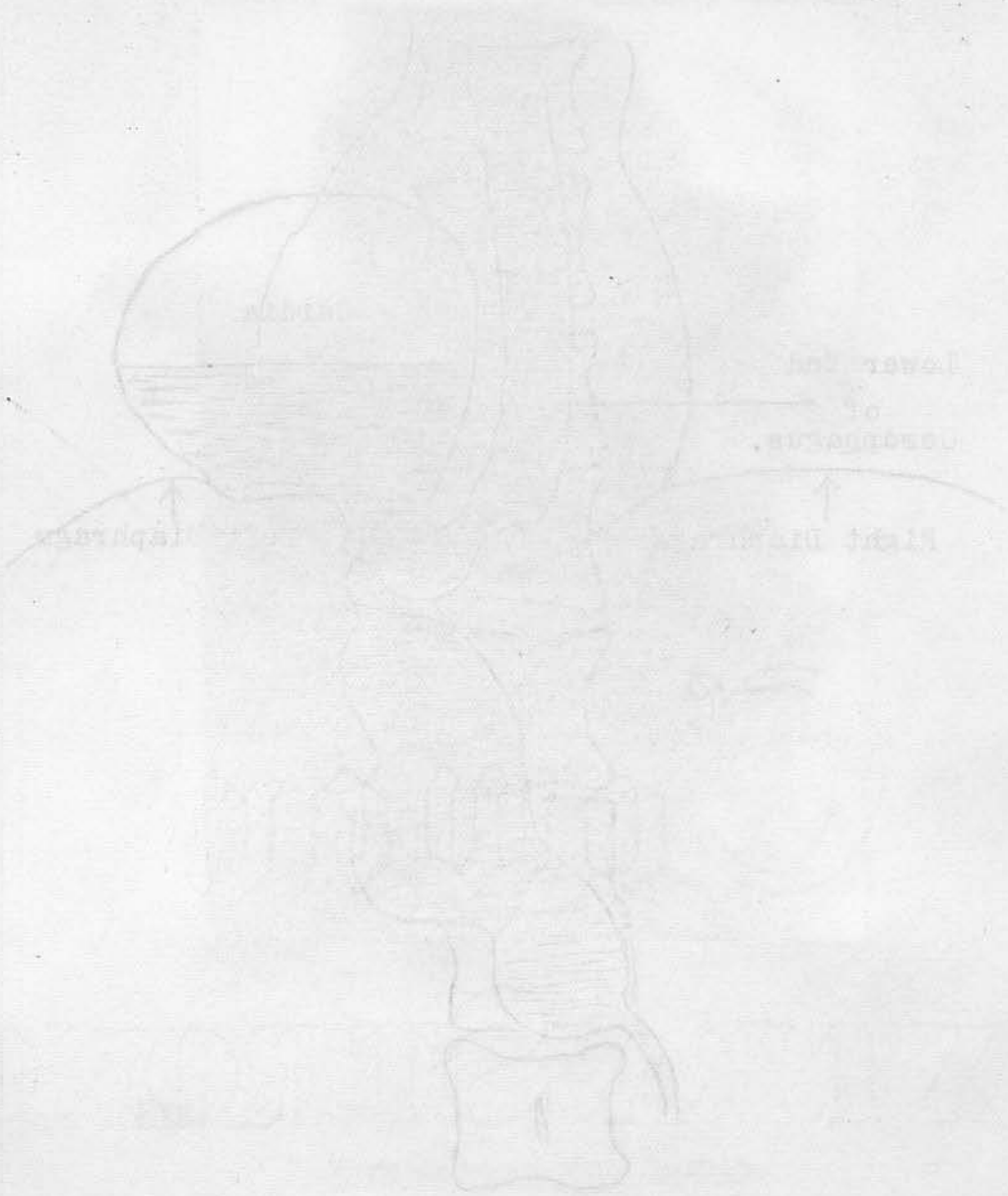
W.J. Male. Age 78.

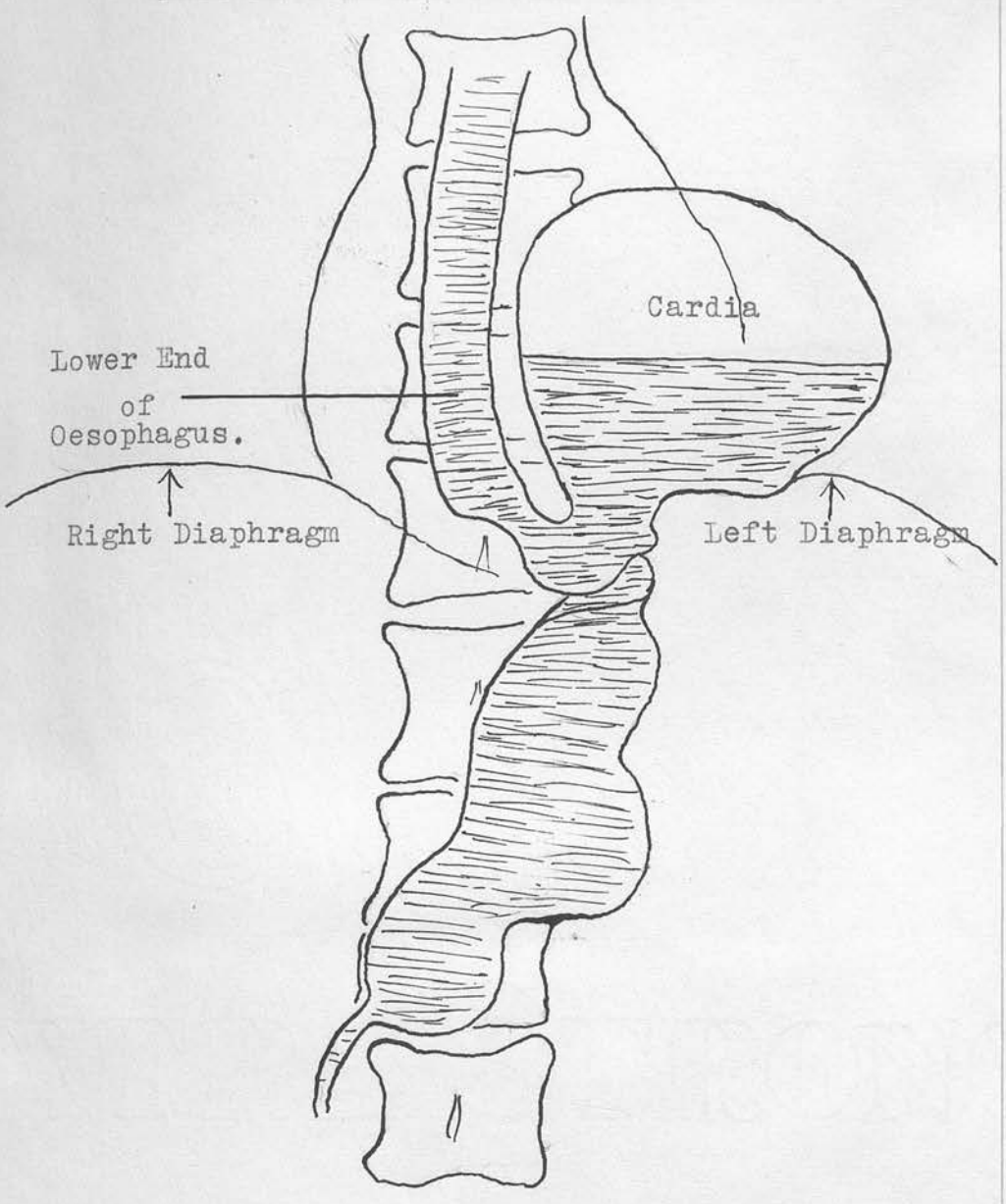
Para-Oesophageal Hernia.

Radiograph in antero-posterior position, with patient erect, showing gas bubble and horizontal fluid level in the herniated portion of the cardia.

The lower end of the oesophagus is seen passing down to the right of the sac.

To face page 166.





Mrs. N.

PARA-OESOPHAGEAL HERNIA.

Plate (57).

Mrs. N.

Para-Oesophageal Hernia.

X-Ray Report: The whole fundus of the stomach is seen to lie above the left diaphragm. In the radiograph it is seen to have passed through the oesophageal hiatus to the left of the lower end of the oesophagus, and to be quite separate from it. The herniated fundus shows the usual large gas bubble. The patient is in the postero-anterior position, and is erect.

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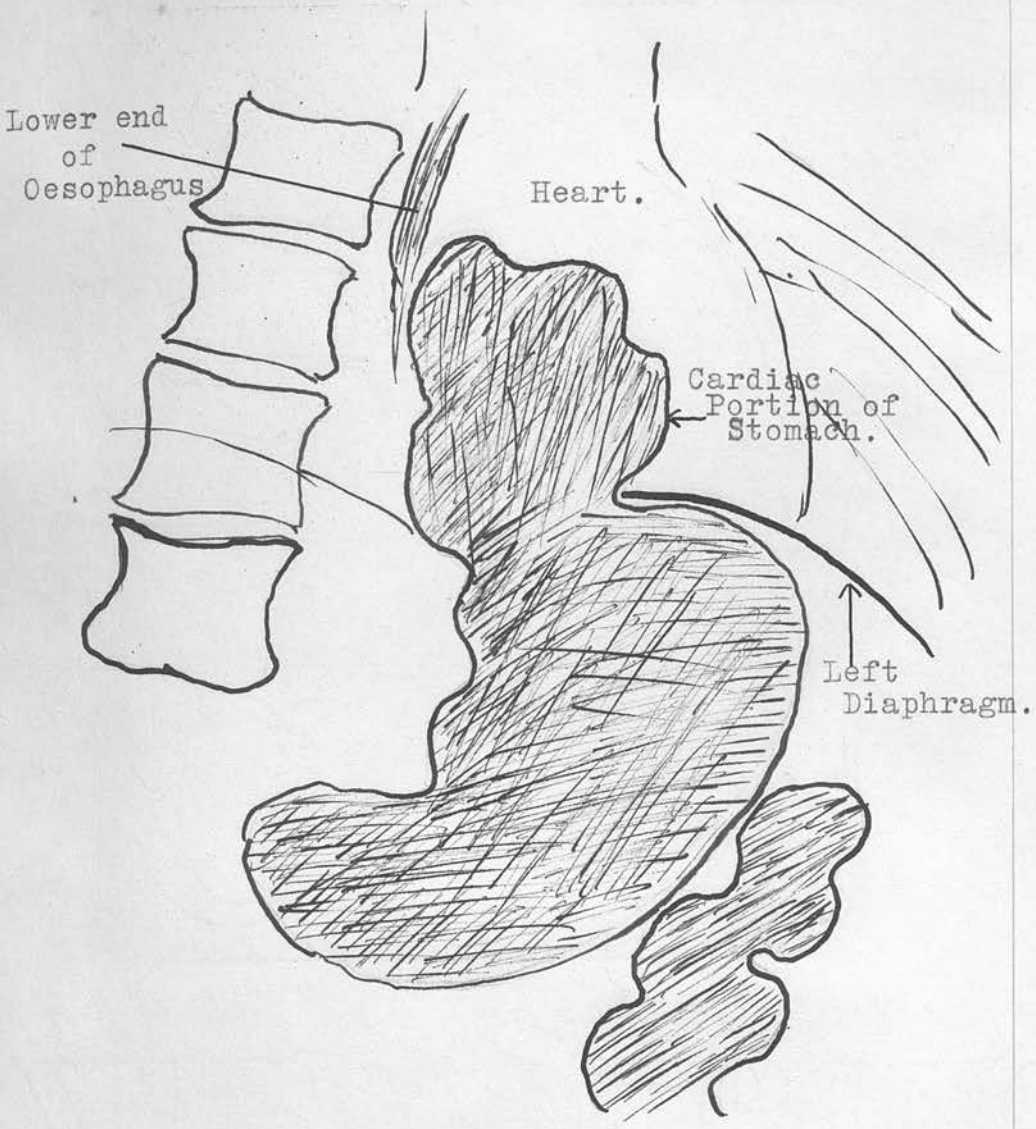


Mrs. W.

PARA-OESOPHAGEAL HERNIA.

Plate (58).

Mrs. W. Age 70.

Para-Oesophageal Hernia.

History: The patient has suffered from "indigestion" on and off since she was a young woman. The symptoms were a burning sensation in the epigastrium and flatulence. At times, nausea and vomiting, but not lately. Duration of present illness, I8 months, during which her complaint has been of indefinite discomfort in the epigastrium after meals, with an occasional stinging pain there. Loss of weight for the last eight months.

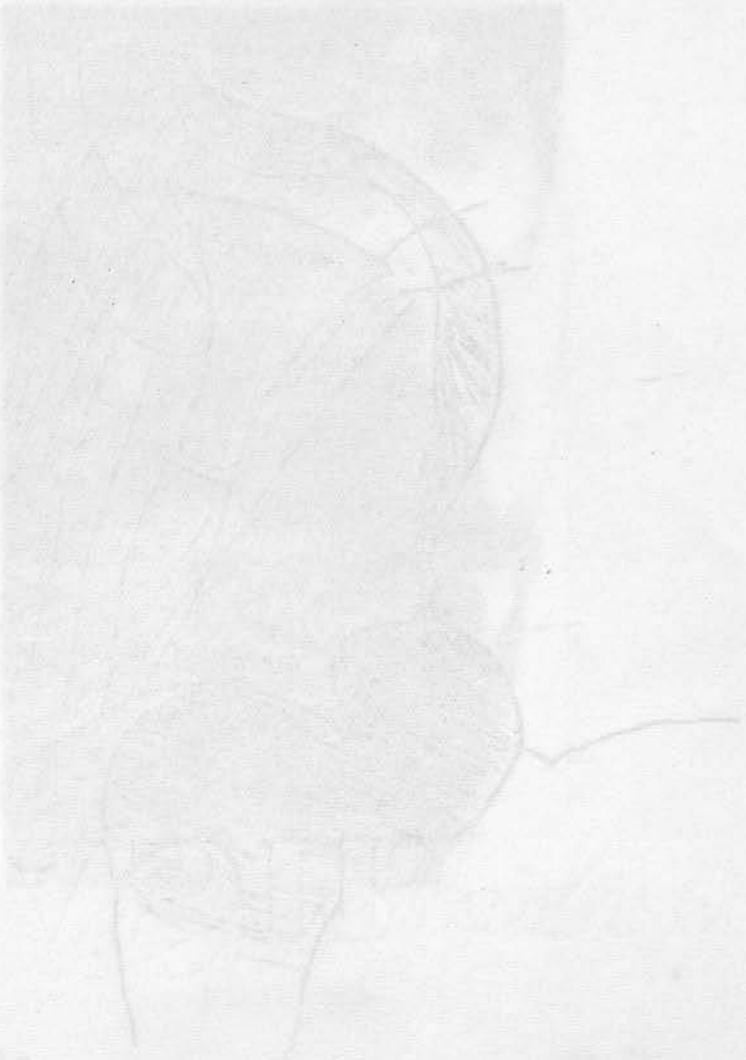
X-Ray Report: There is a large pouch at the lower end of the stomach. In the recumbent position this

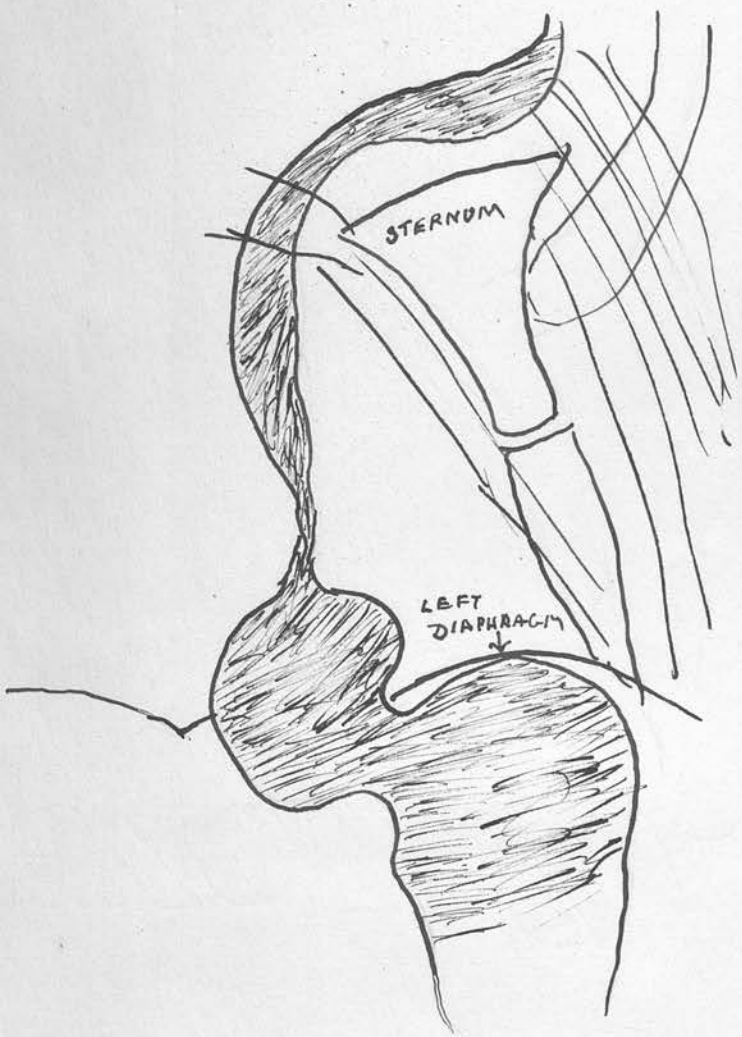
fills up from the stomach, and is seen to be a part of the cardia which has herniated through the oesophageal orifice of the diaphragm. No filling defect of the stomach itself.

The condition is one of para-oesophageal hernia.

The radiograph above is an anterior one, with the patient supine, and shows the herniated portion of the cardiac end of the stomach lying above the left diaphragm.

To face page 169.





J.S.

CARDIO-OESOPHAGEAL RELAXATION.

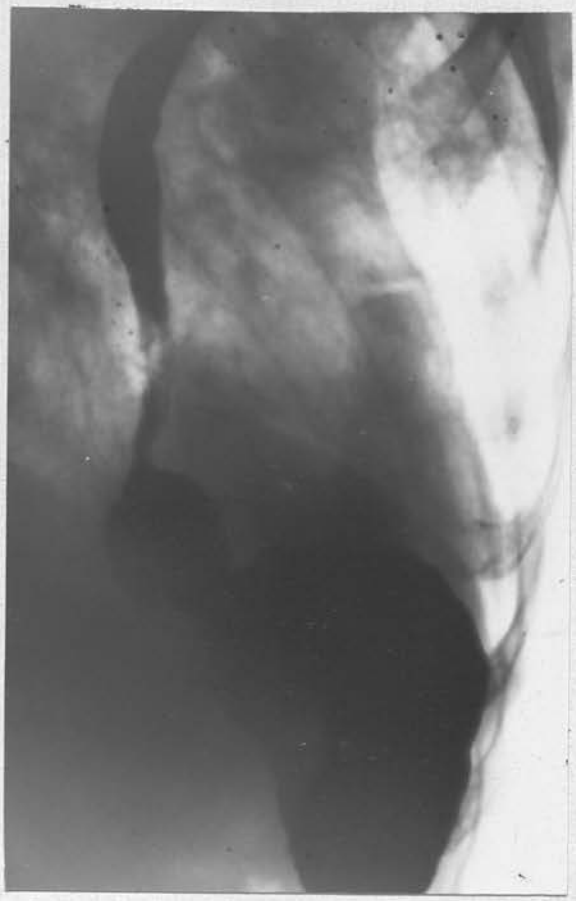


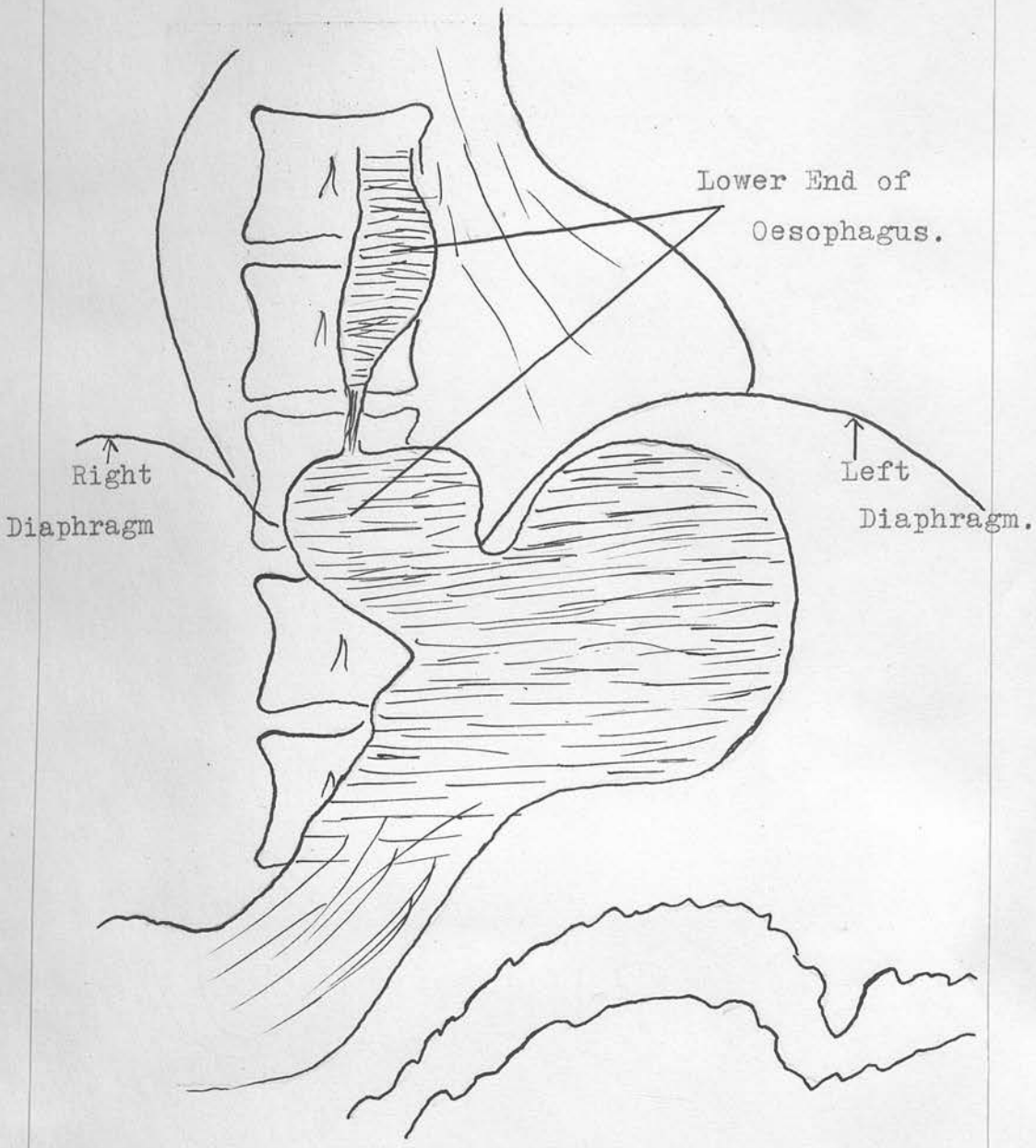
Plate (59).

J.S. Male. Age 50.

Cardio-Oesophageal Relaxation.

The radiogram shows dilatation of the epicardial portion of the oesophagus, with regurgitation of barium into it from the cardiac end of the stomach.

To face page 170.



Mrs. A.

CARDIO-OESOPHAGEAL RELAXATION.

Plate (60).

Mrs. A. Age 66.

Cardio-Oesophageal Relaxation.

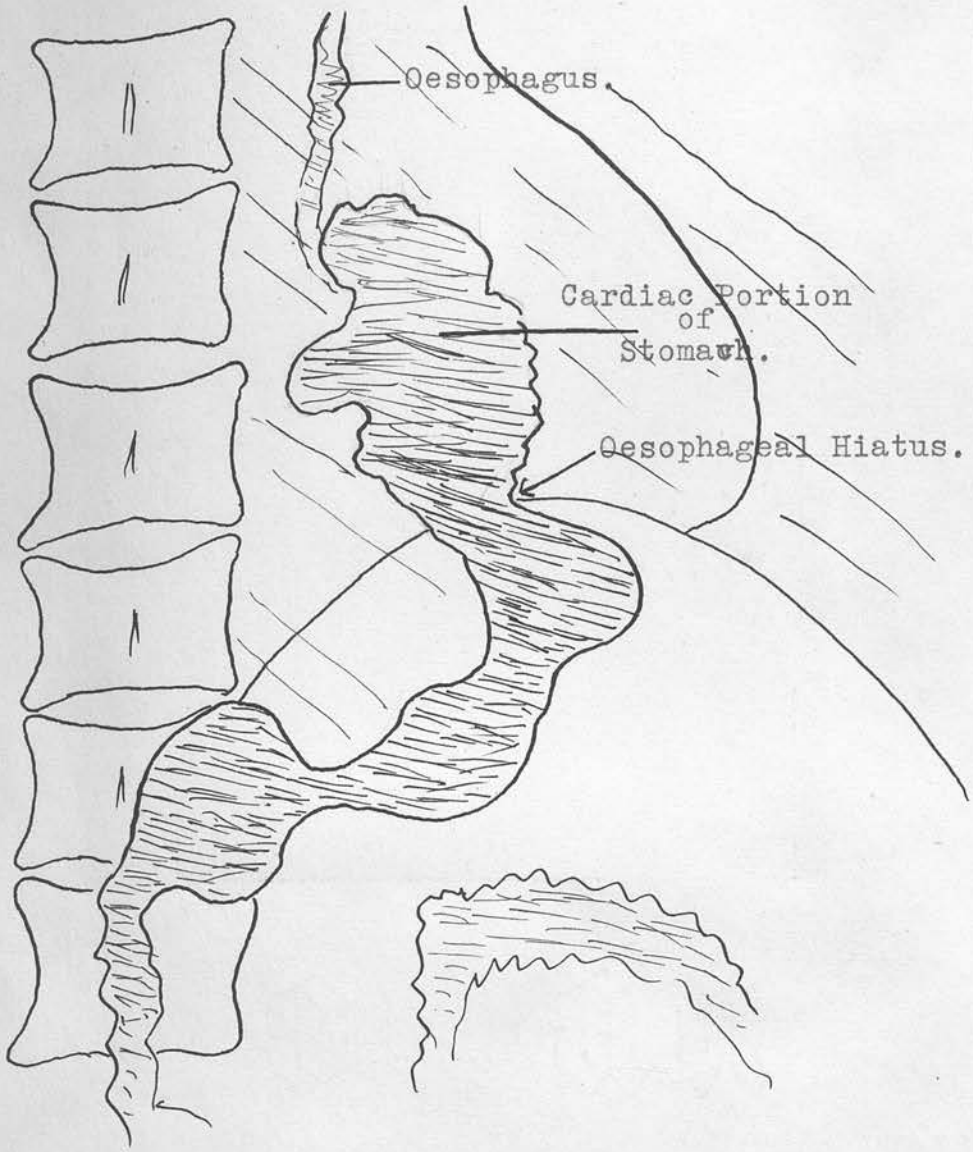
Complaint:

Has had difficulty in swallowing for one year, only solid food giving trouble. If solid food is taken it is retained, but it causes pain on deglutition.

X-Ray Report:

The only abnormal finding was the condition of cardio-oesophageal relaxation which is shown in the radiograph above.

To face page 171.



Mrs. B.

CONGENITAL SHORT OESOPHAGUS.

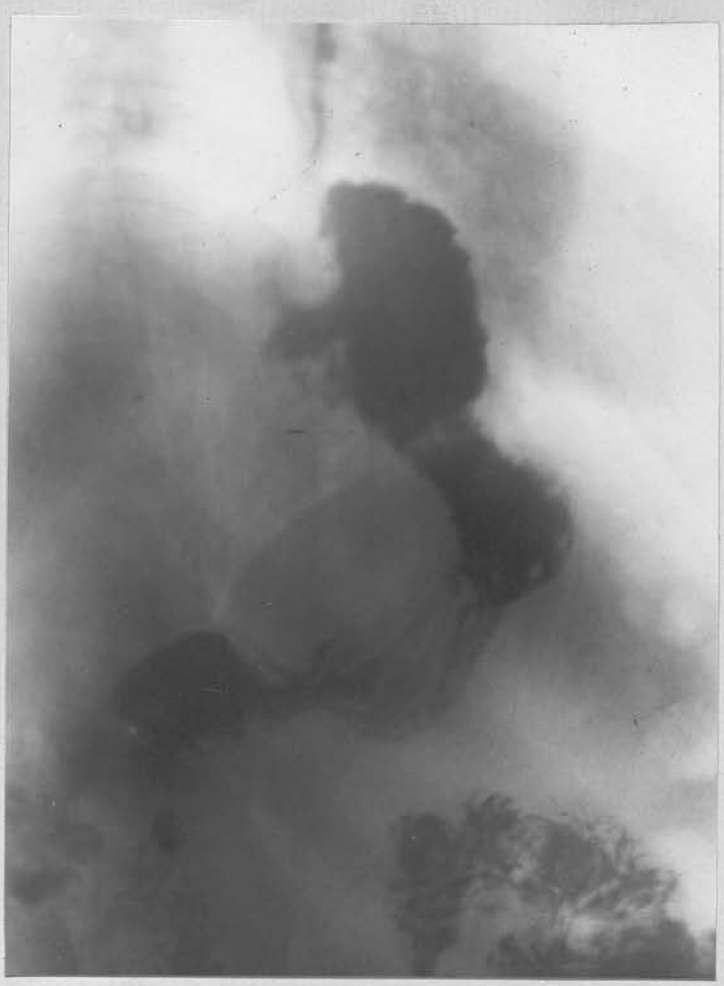


Plate (6I).

Mrs. B.

Congenital Short Oesophagus.

The X-Ray examination showed that the whole cardiac portion of the stomach lay above the diaphragm, replacing the lower end of the oesophagus in the posterior mediastinum. The barium shadow shows the typical crenated outline of the cardiac end of the stomach.

REFERENCES.

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SUMMARY

The aim of this Thesis has been to present a review of the scope , and of the limitations, of the radiological examination in the diagnosis of oesophageal lesions.

After a general description of the special Anatomy and Physiology of the region, and of the technique used in its radiological investigation, the various pathological conditions found are briefly described, with special reference to any X-Ray appearances which may be typical of the lesion.

Wherever possible, prints from radiograms showing the the typical appearances upon which the radiological diagnosis has been made are included.

In conclusion, the following points are put forward:

(I). A full radiological examination by a duly experienced radiologist should be made in the case of every patient presenting himself with symptoms referable to the oesophagus. This X-Ray examination should precede direct examination; in a large proportion of cases it will enable a definite diagnosis to be made.

(2). The danger of an incomplete examination is emphasised--- for instance, if the oesophagus alone is examined, and that only in the erect position, carcinomata of the fundus of the stomach will almost certainly/

certainly be missed, though the condition may be the cause of the dysphagia which led to the examination and may give rise to no other symptoms.

(3). It is of great importance that the fluoroscopic examination should be supplemented by the taking of radiograms, especially in the case of suspected radio-opaque foreign bodies of small size.

(4). There is a well defined group of conditions, embracing most benign tumours of the gullet, superficial ulcerations without cicatricial stenosis, and most transradiant foreign bodies, in which the radiological findings are either very inconclusive or even entirely negative.

In all these cases, the oesophagoscope is the only certain means of diagnosis

Again, in cases in which the radiological examination shows a state of spasm in some part of the oesophagus, it may not be possible to determine whether this is the result of the irritation of some organic intra-oesophageal lesion, such as a peptic ulcer, syphilitic or tubercular ulceration, early carcinoma or some such condition which does not give any direct radiological evidence of its presence, or is of reflex or even purely functional origin.

Here also, direct examination is required in order to determine the exact state of the oesophageal lumen.

(5). Para-Oesophageal, or Hiatus Hernia of the cardiac/

cardiac end of the stomach is not so rare a lesion as has been supposed.

It is almost invariably diagnosed as a result of radiological examination, undertaken on account of a complaint of dysphagia, or of obscure and indefinite gastric symptoms.

Para-Oesophageal Hernia can not be diagnosed except by X-ray examination, or surgical exploration.

(6). The use of any blind method of examination of the oesophagus is quite unjustifiable.

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